~~Royal Med. Soc.~~
~~(EDINBURGH)~~

Medical Essays & Observations

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MEDICAL ESSAYS
AND
OBSERVATIONS,

PUBLISHED BY

A SOCIETY in *EDINBURGH*,

In SIX VOLUMES;

Abridged and diſpoſed under GENERAL HEADS,

In TWO VOLUMES.

CONTAINING

VOL. I.	VOL. II.
METEOROLOGY,	ANATOMY and CHIRURGERY,
MINERAL WATERS,	ESSAYS on particular DISEASES,
MATERIA MEDICA and PHARMACY,	HISTORIES of MORBID CASES,
ANIMAL OECONOMY.	IMPROVEMENTS and DISCOVERIES in PHYSIC.

With COPPER PLATES.

By *WILLIAM LEWIS*, M.B. F.R.S.

LONDON:
Printed for C. HITCH at the *Red Lion*, and
T. ASTLEY at the *Roſe* in *Pater-noſter Row*.

MCCCXLVI.

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THE

PREFACE.

THE reception which the medical essays and observations of the Society at Edinburgh have already met with, is the occasion of this abridgment. Real and useful matters of fact, accurately observed, appear to make up the more valuable part of the original work: These have been carefully preserved in the abridgment. An instance of our method we shall give in the meteorological tables, which although reduced to one half of their original bulk, yet we hope are not less clear and distinct, since nothing is omitted save prefixing to every day the hour of observation, which being pretty nearly the same was thought to be fully supplied with one general remark. Of the whole work but three essays are omitted: One of these the Society seem to have had an inclination to have dropped themselves; and the other two were accidentally left out in the abridgment. A mere catalogue of books, without any criticism or remarks on any of them, appeared as useless an article, as it is a dull entertainment: We had therefore, from the writings of others and our own observation, taken no small pains to embellish this part of the work: But,

as by this means the matter had unavoidably increaſed to too great a bulk, we were obliged to omit it, as inconſiſtent with the general deſign of this undertaking; which was, to give the whole of this excellent work in as ſmall a compaſs as poſſible, and thereby make it more extenſively uſeful. We have endeavoured to abridge the words not the matter, and, without any comment of our own, fairly to give the author's ſentiment, in the manner which he ſeemed to us to have intended; and where it appeared doubtful, the very expreſſion is literally kept. It was propoſed at firſt to have interperſed ſome occaſional notes; but when the work came to be throughly examined, there appeared no real occaſion for any. Thus far the abridger thought neceſſary to acquaint the public, with regard to his undertaking. With regard to the general work, the Society have prefixed to the ſeveral volumes which compoſe it, a conciſe account of their method of obſervation, rules obſerved in relating matters of fact, &c. The conciſeneſs of this narrative will not admit of much abridgment; we ſhall therefore extract ſuch part as is for the preſent purpoſe, and give it nearly in their own words.

The neceſſity of making medical obſervations, and communicating them to the public, is ſufficiently obvious to every phyſician: But phyſicians of the Britiſh dominions have particular reaſons to be employed this way; ſeeing we have been favoured with very few of our own, and that our climate, way of living, and other circumſtances, which ought to be greatly regarded

in

in the cure of diseases, are very different from most inhabitants of the continent; to which may be added, that every nation has its own prevailing mode of prescribing. On these accounts, young practicers must be under the greatest difficulty to accommodate foreign observations to their own practice. The necessity of establishing physic on a better footing among us, will still appear in a stronger light, upon taking a view of the different manners in which observations are handed down to us. Those who publish volumes of their own practice, improvements and discoveries, undertake a task very difficult to be executed as it ought, because of the qualifications necessary for it, which chiefly are sagacity and knowledge, to guard against errors and mistakes in the names and nature of things, and to distinguish between trifling facts, and such as are necessary to be remarked: Accuracy, to omit no essential circumstance; and candour, to conceal nothing material.

Several collections of observations, communicated to some considerable men by their correspondents, have been published, and seemed to promise more accuracy and candour, by passing through the hands of a censor equal to the task; but even in these, we find plain marks of the publisher's too great complaisance, or of his fear to offend. The only collections of this kind continued of late, are the Acta Medica Berolinensia, and Acta Wratislaviensia; both these at least labour under the disadvantages common to all foreign observators. The first seems to be wholly composed by the publisher, without as-

ſiſtance, or exact memoirs; and the ſecond is in a language (the High Dutch) very little underſtood by the Britiſh, and contains many papers foreign to the immediate improvement of phyſic. The laſt method of communicating obſervations has been in collections made by ſocieties; the moſt conſpicuous of which are the royal ſociety in London, the academie royale des ſciences at Paris, the acedemia ſcientiarum imperialis at Peterſburg, and the academia naturæ curioſorum in Germany; all inſtituted by public authority, for the advancement of natural knowledge, under which the ſeveral branches of medicine are comprehended. The philoſophical tranſactions, and memoires de mathematique and de phyſique, are valuable treaſures; but the conſtitution of the Engliſh ſociety and French academy does not allow them to inſert ſeveral things which a plan calculated only for the improvement of phyſic would eaſily admit. The Peterſburg tranſactions are yet of ſhort ſtanding, two volumes being only publiſhed, and are much on the ſame plan with the former two. The collections of the academia naturæ curioſorum appear to be more calculated for the immediate improvement of medicine than any of the former; but beſides containing many papers of natural hiſtory and philoſophy, and being liable to the inconveniencies of other foreign obſervations, they omit ſeveral neceſſary articles, which, in our opinion, ought to be taken in. All we would be underſtood to infer from theſe remarks, is, that the charges of ſome, and the mixture of other ſciences with the medical pa-

pers,

pers, prevent their being so generally sought after; others are not calculated for our climate and practice; and some are to be read with caution: From all which we would conclude, that a collection of observations wholly relative to medicine, made in our own country, and candidly and accurately related, would be the most effectual way to improve physic among us. The desire we have to remove the disadvantages, which in our opinion medicine lies under, is the only motive that prevailed with us to undertake a yearly collection of medical essays and observations, on the plan which we here present the reader with, that he may at one view be let into the whole design.

I. A register of the height of the barometer, degrees of the thermometer and hygroscope, the quantity of rain that falls, the direction and force of the wind, and state of the weather at Edinburgh for twelve months; compared with observations of the same kind communicated by correspondents.

II. An account of the diseases which have been epidemic, or most universal in Edinburgh, in the several seasons of the preceding year, with an extract from the records of the burials.

III. Observations and essays on the following subjects, 1. History of any part of physic. 2. Simple drugs. 3. Compound Galenical medicines. 4. Chemical operations and experiments.

ments. 5. Anatomy. 6. Animal Oeconomy. 7. Theory, and 8. Practice of surgery and physic.

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A
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Of the AUTHORS of the original Papers abridged in the following Work.

MEDICAL

MEDICAL ESSAYS AND OBSERVATIONS, &c.

The Description of EDINBURGH.

THE city of Edinburgh is ſituated on the ridge of a hill, in the longitude of 3° weſt from London, and in the north latitude of 55° 55′. It is about a mile long, and near half as broad. The loweſt part (Holy-rood-houſe) is ninety-four feet higher than the ſea, from whence it aſcends in a direction nearly weſt-ſouth-weſt, to its higheſt part (the Caſtle-hill). The perpendicular height of this aſcent, is one hundred and eighty feet. The ridge of the hill is one large ſtreet divided by a gate; the upper diviſion is called the High-town, the lower the Cannon-gate. From the north ſide of the High-ſtreet deſcend narrow and ſteep lanes to the brow of the hill, where are large gardens, and a lake (Noreloch) of freſh water. Here the butchers have their ſlaughter-houſes, and the tanners their pits. On the ſouth-ſide the lanes are broader and leſs ſteep. They terminate in a narrow ſtreet (the Cowgate) parallel to the High-ſtreet. Here are plenty of ſprings of water, which, after violent rains, forces its way through the ground-floors. Betwixt this and the city wall, which runs along another ridge of the hill, are gardens, burying-places, &c. and in this place the brewers have their brewhouſes. The Cannongate has narrow lanes going off from each ſide of the ſtreet, at the end of which are large gardens.

The ſtreets of Edinburgh are narrow, the houſes high and cloſe built; ſeveral families are crouded into one of them, which occaſions the place not to be ſo cleanly as others which have greater conveniencies. There is no river nearer the town than three fourths of a mile, but it is plentifully ſupplied with fine ſpring-water through leaden pipes. The markets are well furniſhed with fleſh, fiſh, fruit, herbs, and roots; the common drink is ſmall ale, but the people of faſhion have plenty of wines. Wheat bread is generally made uſe of, but the poor feed much on oatmeal. The common fuel is pitcoal. The number of inhabitants in Edinburgh amounts to upwards of thirty-two thouſand, allowing the number of thoſe who die to be one thirtieth of the whole; or each family to conſiſt of five perſons. But this eſtimate appears rather too ſmall for ſuch a crowded and healthful place. At the upper end of the High-ſtreet, weſtward, there is a high rock, on which the caſtle is built. On the north ſide of the foot of it begins the Noreloch, and is continued at the foot of the ridge, on which the town ſtands, for three fourths of the High-ſtreet. Towards the caſtle it is three hundred foot broad, but lower down only two hundred and fifty. The ground on the north ſide of it, is lower than that on which the town ſtands. The Cannongate is overtop'd on the north ſide by a contiguous hill. Beyond the loweſt extremity of the Cannongate runs a plain, ſloping eaſtward to the ſea; but to the ſouth of Holy-rood-houſe ariſe two very high hills, at a ſmall diſtance. The ground to the ſouth of the Cannongate is higher than the houſes, but that to the ſouth of the High-town is much on a level with it, and has many houſes built on it. The High-ſtreet, near the Caſtle-hill, is the higheſt place within a mile. Thus it appears that the caſtle is higher than the town between weſt-ſouth-weſt, and weſt-by-ſouth. Some high rocks ſhelter part of the town from the north-eaſt winds; high hills and rocks defend it from the eaſt winds; and the ſouth-ſide of the Cannon-gate and Cow-gate are defended by their own

low ſituation, while the High-town is open from the weſt to the north-eaſt points, and from the weſt-ſouth-weſt to the eaſt-ſouth-eaſt; all parts are expoſed to the winds between the north-eaſt and eaſt. At two miles diſtance, weſtward, are ſome hills higher than the city. At a mile's diſtance is the frith of Forth, a branch of the German ocean, and is there about ſeven miles in breadth, but gradually grows narrower till it is only named the river of Forth. The tide, however, riſes at twenty miles diſtance from Edinburgh. Ten miles ſouth from Edinburgh are high hills running eaſtward; two miles ſouth are hills higher than any part of the town; and five miles ſouth begins a great range of hills, running ſouth-weſt; beyond which a ſpacious plain, watered with ſeveral rivulets, is extended many miles weſtward.

METEOROLOGY.

A deſcription of the inſtruments with which the obſervations in the meteorological regiſter were made.

THE barometer is a portable one; the bore of its tube is about one fourth of an inch diameter; it is kept in a room two hundred and ſeventy feet above the ſea. The different heights of the mercury are marked in the regiſter by inches and tenths of inches, which meaſure is alſo made uſe of in determining the degrees of the thermometer and hygroſcope. The thermometer is the common ſpirit thermometer; the freezing point is at eight inches two tenths, and the heat of a man in health raiſes the ſpirit to twenty-two inches two tenths. The hygroſcope is compoſed of a whip-cord and a plummet; the difference in the length of the cord, when fully dry'd, to its length when fully wet, is four inches and an half; the point of greateſt dryneſs on the ſcale, is at five tenths of an inch,

inch, and the point of the fulleſt wetneſs is five inches. The thermometer and hygroſcope are kept in a box placed on the outſide of the north window. By the ſituation and make of it, neither the ſun nor rain, no fire or company in the room, can have any effect on the inſtruments; yet care is taken that the air have free acceſs to them. The direction of the wind is obſerved by the weather-cock on the high ſteeple of St. Giles's church. The ſtrength of the wind we judged of by our ſenſes, without any inſtrument, and marked the ſeveral degrees thus, 0, 1, 2, 3, 4; 0, denotes a perfect calm; 1, a ſcarce ſenſible wind; 4, a hurricane; 2, 3, intermediate forces. The inſtrument for determining the depth of rain, is made of a funnel twenty-eight inches diameter, placed about the middle height of the city, free from all over-topping houſes or trees. The gage is a cylindrical glaſs, whoſe diameter is exactly one tenth of the funnel, and is divided into inches and tenths of inches. The difference of the diameters of the funnel and the gage, ſhews that one hundredth part of what is meaſured in the gage, is only to be reckoned the true quantity that falls.

Meteorological Tables (*a*).

(a) The hours in which the obſervations ſet down in the following tables, were taken, are omitted; ſince a ſmall matter of difference herein, could not ſenſibly affect a journal of the weather, eſpecially in comparing one day with another. However, it may be convenient to inform the reader, that the general time of obſervation was about eight of the clock in the forenoon, and five in the afternoon.

An explication of the abbreviations.

Clea, clear; clo, cloudy; haz, hazy; vari, variable; low, lowring; driz, drizling; g. ra, great rain; ſtor, ſtormy; ſno, ſnow; temp, tempeſt; thun, thunder; ligh, lightening; freſ, freſh.

JUNE

JUNE, 1731.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n	Thermom. Aft^n.	Hygrosc. For^n	Hygrosc. Aft^n.	Wind. Forenoon. Direct	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	30 1	30 1	15 6	16 0	1 8	1 6	S. w. *b* f.	1	S. w. *b* f.	0	fair	clou	— —
2	29 9	29 9	15 3	15 9	1 7	1 7	S. w.	1	W.	2	clou	clou	
3	30 0	30 0	14 4	14 0	2 1	2 3	W.	1	N. w.	1	clou	rain	
4	29 9	30 0	12 2	13 0	1 7	1 5	N. w.	2	N. w.	2	clou	clou	0 063
5	30 0	30 0	10 6	12 7	1 9	1 6	N. w. *b* n.	2	N.	1	hail	clou	0 022
6	30 0	30 0	12 4	13 7	2 1	1 8	N. w.	1	N. w.	1	clou	clou	— —
7	30 0	30 0	12 2	12 7	2 3	2 0	N. e.	1	N. e.	1	clou	fair	0 023
8	30 0	30 0	13 5	15 2	2 1	1 7	W.	1	W. *b* n.	1	clou	clou	— —
9	30 0	29 9	13 2	15 0	1 9	2 0	W.	1	W.	0	clou	clou	— —
10	29 7	29 6	13 3	13 8	1 8	2 1	W.	0	W.	0	clou	rain	— —
11	29 5	29 6	14 4	13 8	1 8	2 0	W.	1	W.	1	clou	clou	0 098
12	29 8	29 8	13 3	12 9	2 3	2 5	N. e.	1	N. e.	1	clou	clou	— —
13	29 7	29 7	13 0	13 2	2 6	2 4	N. e.	1	N. e.	1	clou	clou	— —
14	29 8	29 8	12 2	13 1	2 9	2 6	N. e.	1	N. e.	1	clou	fair	— —
15	29 8	29 9	14 4	13 5	2 2	2 5	N. *b* w.	1	N. *b* e.	1	fair	clou	— —
16	29 9	30 0	12 2	12 9	3 2	3 0	N. e.	1	E. *b* n.	1	clou	haz.	— —
17	30 0	30 0	12 0	12 3	2 9	2 8	E.	1	E.	1	clou	clou	0 002
18	30 0	29 9	11 5	12 7	3 1	2 5	E.	1	E.	1	clou	fair	0 002
19	29 8	29 6	12 7	12 8	2 5	2 8	E. *b* n.	1	E. *b* n.	1	fog	fog	— —
20	29 5	29 5	12 6	12 9	3 3	2 6	E. *b* n.	1	E. *b* n.	1	fog	clou	0 064
21	29 4	29 4	12 3	13 5	2 2	1 5	N. *b* w.	1	N. *b* w.	2	clou	clou	0 075
22	29 5	29 5	12 0	13 8	1 5	1 2	N. w.	2	N. w.	1	clou	clou	— —
23	29 5	29 5	12 1	12 3	2 0	3 0	S. e.	1	E. *b* n.	1	rain	rain	0 185
24	29 5	29 4	13 7	14 6	2 8	1 9	E. *b* n.	1	S. w.	2	fog	clou	0 176
25	29 2	29 1	13 9	14 1	2 0	1 8	S.	2	S.	2	clou	rain	0 255
26	29 5	29 6	13 5	13 3	2 0	2 0	W.	0	W.	1	clou	fair	0 010
27	29 6	29 6	11 1	11 4	3 3	3 2	N. e.	2	N. e.	2	rain	rain	
28	29 5	29 6	11 4	12 4	3 7	3 3	N. e.	2	W.	1	fog	fog	1 060
29	29 6	29 7	13 0	13 8	3 0	2 8	W.	2	W.	2	clou	clou	0 020
30	29 7	29 7	14 0	14 0	2 1	1 7	W.	2	W.	3	fair	fair	— —

Total Depth 2, 055

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 5	13 2	2 3
Greatest Height ———	30 1	16 0	3 7
Least Height ———	29 1	10 6	1 2

JULY, 1731.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 9	29 9	13 7	13 6	1 7	1 7	W.	2	W. *b* n.	1	fair	fair	— —
2	30 0	30 0	13 4	14 3	2 1	1 8	N.	1	N. *b* e.	1	fair	fair	— —
3	30 0	30 0	13 9	15 2	1 8	1 4	N. *b* w.	1	W.	1	fair	fair	— —
4	30 0	30 0	14 6	16 2	1 6	1 2	W. *b* n.	1	W. *b* n.	1	fair	fair	— —
5	29 9	29 8	15 2	15 6	1 4	1 6	W.	1	N. e.	1	fair	fair	— —
6	29 8	29 8	13 4	13 4	2 5	2 4	N. e.	1	N. e.	1	fair	clou	— —
7	29 8	29 8	13 3	14 5	3 0	2 2	N. e.	1	E.	1	fog	fair	— —
8	29 8	29 9	14 3	14 9	2 2	2 0	N. e.	1	N. e.	1	fair	fog	— —
9	29 9		14 2		2 1		E.	0			fair		0 016
10	30 0	30 0	14 1	15 5	1 8	1 5	W.	2	W.	3	fair	fair	— —
11	29 9	29 9	13 9	14 9	1 6	1 4	W.	2	W.	2	fair	fair	— —
12	29 9	29 8	13 8	14 6	1 8	1 3	W.	2	W.	1	fair	fair	— —
13	29 8	29 7	14 2	14 3	1 8	1 6	W.	1	N. *b* e.	1	rain	fair	0 012
14	29 7	29 7	13 6	14 5	1 4	1 7	N. e.	0	N.	1	rain	clou	0 243
15	29 6	29 6	13 5	14 5	1 9	1 3	W.	0	W.	1	rain	fair	0 080
16	29 6	29 7	13 4	14 1	1 6	1 4	N. w.	1	N. *b* e.	0	clou	clou	— —
17	29 7	29 7	13 1	13 7	1 4	1 2	E. *b* n.	1	N. e.	1	fair	clou	— —
18	29 8	29 9	12 6	14 0	1 4	1 2	N. e.	1	N. e.	1	fair	fair	0 027
19	29 9	29 8	13 3	15 2	1 5	1 1	W. *b* s.	1	W.	1	fair	fair	— —
20	29 7	29 6	14 2	14 6	1 4	1 3	S. *b* w.	1	S.	1	clou	rain	— —
21	29 4	29 4	14 9	15 3	1 8	1 3	S. *b* w.	1	W. *b* s.	1	clou	clou	0 243
22	29 5	29 5	14 1	15 8	1 6	1 2	W.	1	S. w.	1	clou	fair	0 007
23	29 5	29 5	14 6	15 7	1 8	1 5	S.	1	S.	0	rain	clou	0 255
24	29 6	29 6	13 7	15 0	1 9	1 2	W.	1	W.	1	clou	fair	— —
25	29 6	29 6	14 6	15 0	1 7	0 9	N.	1	N.	0	clou	fair	0 147
26	29 7	29 8	13 4	15 0	1 5	0 9	W.	1	W.	1	fair	fair	— —
27	29 8	29 7	14 2	15 0	1 3	1 8	S. w.	0	W.	1	clou	clou	0 243
28	29 7	29 8	15 2	15 0	1 9	1 4	W.	1	S.	2	clou	clou	0 010
29	29 8	29 8	15 7	15 1	1 4	1 1	S. *b* w.	1	S. *b* w.	1	clou	clou	— —
30	29 8	29 7	15 5	16 0	1 5	1 3	S. *b* e.	1	E.	1	clou	thun	0 065
31	29 7	29 6	14 5	14 2	2 6	2 5	E. *b* n.	1	E.	1	mist	thun	0 193

Total Depth 1, 541

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	14 2	1 6
Greatest Height	30 0	16 2	3 0
Least Height	29 4	12 6	0 9

AUGUST, 1731.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	fo.	Wind. Afternoon. Direct.	fo.	Weath Fo.	Weath Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 6	29 6	15 4	15 5	2 0	2 0	S. e.	1	S. e.	1	clou	rain	0 044
2	29 5	29 6	13 2	14 8	3 8	3 1	E.	1	E.	1	rain	fair	0 736
3	29 8	29 8	13 8	14 9	2 9	2 6	E.	1	E.	1	fair	fair	0 003
4	29 9	29 9	13 9	13 8	3 1	2 5	E.	1	E.	1	clou	fair	— —
5	29 9	29 9	13 1	14 0	2 9	2 4	E.	1	E.	1	clou	clou	— —
6	29 9	29 9	13 7	14 6	2 6	2 1	E.	1	E.	1	fair	fair	— —
7	29 9	29 9	14 0	15 5	2 6	2 0	E.	1	E.	1	clou	fair	— —
8	29 9	29 8	14 8	15 7	2 0	1 5	N.	1	N.	1	clou	fair	— —
9	29 5	29 4	13 8	13 4	1 8	1 4	N. w.	2	N. w.	2	fair	fair	— —
10	29 5	29 7	12 7	13 2	1 3	1 2	N.	2	N. w.	1	clou	fair	— —
11	29 9	29 9	11 9	14 1	1 2	1 0	N. w.	1	N. w.	1	fair	fair	— —
12	30 0	30 1	13 0	14 9	1 4	1 1	N. w.	1	W.	1	fair	fair	— —
13	30 1	30 1	12 7	14 8	1 4	1 0	W.	1	W. *b* n.	2	fair	fair	— —
14	30 1	30 1	14 0	14 8	1 4	1 2	W. *b* n.	1	N.	1	fair	fair	— —
15	30 1	30 1	13 5	13 7	1 8	1 5	N. e.	1	E. *b* n.	1	clou	clou	— —
16	30 1	30 0	12 6	12 9	1 5	1 9	E. *b* n.	1	E. *b* n.	1	clou	clou	— —
17	30 0	30 0	13 4	13 9	1 7	1 1	N. e.	1	S. *b* e.	1	clou	fair	0 008
18	30 0	30 0	12 9	13 5	2 3	1 7	E.	1	N. e.	2	fair	fair	— —
19	30 1	30 1	13 1	13 2	2 0	1 7	E.	1	E. *b* n.	1	clou	fair	— —
20	30 1	30 0	12 4	13 2	1 8	1 6	E. *b* n.	1	E. *b* n.	1	clou	clou	— —
21	30 0	29 9	12 8	13 0	2 0	1 9	E. *b* n.	1	E. *b* n.	1	clou	clou	— —
22	29 8	29 6	12 8	12 7	1 8	2 2	E. *b* n.	1	E. *b* n.	2	clou	clou	— —
23	29 5	29 5	13 1	13 2	2 9	3 7	E. *b* n.	2	N. e.	1	clou	rain	0 069
24	29 4	29 5	12 6	12 8	3 8	2 7	N. e.	1	N. e.	1	clou	clou	0 209
25	29 6	29 6	12 2	12 8	2 3	1 7	E. *b* n.	1	E.	1	clou	clou	— —
26	29 6	29 6	12 0	11 9	2 4	2 6	E.	2	E.	1	rain	rain	0 164
27	29 4	29 4	12 6	13 5	3 8	2 5	N. *b* e.	1	N. *b* e.	0	fair	fair	0 485
28	29 4	29 4	12 8	13 8	3 5	3 3	N. *b* e.	1	N. *b* e.	1	mist	fog	0 033
29	29 4	29 4	13 6	13 5	2 8	3 3	N. *b* e.	0	N. *b* e.	0	fog	fog	
30	29 4	29 4	13 3	13 8	3 4	3 3	N. e.	0	E. *b* n.	1	clou	mist	0 083
31	29 4	29 4	13 7	14 6	2 9	2 1	W.	1	S. w.	1	clou	clou	0 031

Total Depth 1, 857

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	13 5	2 2
Greatest Height	30 1	15 7	3 8
Least Height	29 4	11 9	1 0

SEPTEMBER, 1731.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrofc. For^n.	Hygrofc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 4	29 4	13 6	13 7	2 3	2 2	S. w.	1	S.	0	clou	fair	0 025
2	29 3	29 2	14 7	13 5	2 3	2 1	S. w.	2	S. w.	2	rain	vari	0 566
3	29 2	29 2	12 8	13 9	2 2	1 6	W. *b* ſ.	2	W. *b* ſ.	3	vari	fair	
4	29 1	29 1	13 3	12 9	2 0	1 7	W. *b* ſ.	3	W. *b* ſ.	3	low	vari	0 195
5	29 3	29 5	12 0	12 8	1 7	1 5	W. *b.* n.	4	W. *b* n.	3	fair	clou	
6	29 4	29 4	13 0	13 0	1 7	1 3	W.	3	W.	3	clea	clou	0 091
7	29 4	29 5	11 7	13 2	1 7	1 2	W.	3	N. w.	2	clou	clou	— —
8	29 7	29 8	11 3	12 4	1 3	1 4	N. w.	2	N. *b* w.	2	clea	vari	— —
9	30 0	30 0	10 7	12 5	1 4	1 2	W.	1	W.	1	fair	clou	— —
10	30 0	30 0	12 7	13 3	1 1	1 8	W.	2	W.	1	clea	clou	— —
11	30 0	30 0	12 4	13 6	2 0	1 3	W. *b* ſ.	1	W.	2	clea	clea	— —
12	29 9	29 8	13 0	13 6	1 7	1 7	S. w.	1	S. w.	2	clou	vari	0 022
13	29 9	30 0	13 1	14 1	2 0	1 4	W.	1	W.	1	fair	fair	— —
14	30 1	30 2	13 0	14 5	2 0	1 7	W.	1	W.	1	fair	fair	— —
15	30 1	30 1	13 2	14 0	1 8	1 8	W. *b* n.	1	N. w.	0	fair	fair	— —
16	30 0	29 9	13 0	14 6	1 8	1 4	S. w.	0	S. w.	0	fair	clea	— —
17	29 8	29 8	13 6	13 2	1 6	1 4	S. w.	2	W.	3	fair	clou	— —
18	29 6	29 4	12 5	12 4	1 5	1 5	S. w.	3	S. w.	2	clou	vari	0 003
19	29 6	29 7	11 9	12 9	1 5	1 5	W.	2	W.	2	clea	clou	0 150
20	29 7	29 7	13 1	13 6	1 7	1 5	S. w.	2	S. w.	1	clou	clou	0 054
21	29 6	29 5	13 6	14 5	1 6	1 5	S. *b* w.	2	S. *b* w.	3	fair	fair	— —
22	29 6	29 5	12 2	12 0	2 2	2 4	W.	1	N. e.	1	rain	vari	
23	29 6	29 7	11 2	11 9	2 5	2 0	W. *b* n.	1	W. *b* n.	1	rain	fair	0 763
24	29 9	29 9	11 2	11 7	2 0	1 8	N. w.	1	N. w.	1	fair	fair	0 030
25	29 8	29 7	11 3	12 1	1 7	1 7	S. e.	1	S. e.	1	fair	fair	— —
26	29 6	29 5	12 8	14 0	2 2	1 9	S. e.	1	S. e.	1	clou	clou	— —
27	29 3	29 2	13 0	13 2	2 0	1 8	S. e.	1	S.	1	clou	vari	0 045
28	29 4	29 2	12 5	13 0	1 8	1 7	S. *b* w.	1	S.	1	fair	rain	0 012
29	29 0	29 4	13 0	13 1	1 6	1 6	W. *b* ſ.	4	W.	3	ſtor	clea	0 155
30	29 3	29 3	14 3	14 3	1 9	1 5	S.	2	S. w.	3	clou	clou	0 010

Total Depth 2, 12

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	12 9	1 7
Greateſt Height	30 2	14 7	2 5
Leaſt Height	29 0	10 7	1 1

OCTOBER, 1731.

Day	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygroſc. For^n.	Hygroſc. Aft^n.	Wind Forenoon Direct.	fo.	Wind Afternoon Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 4	29 6	12 1	12 8	1 8	1 8	S. w.	3	S. w.	2	v ri	vari	0 085
2	29 6	29 7	13 6	14 3	1 9	1 7	S. w.	3	S. w.	3	v ri	clou	
3	29 9	29 9	12 2	13 0	2 0	1 5	W.	2	W.	2	clea	clea	
4	29 8	29 8	12 0	11 7	1 4	1 6	W.	1	N. w.	1	rain	vari	0 390
5	29 0	29 8	10 5	11 8	2 5	1 8	S. w.	1	S. w.	2	fair	vari	0 007
6	29 7	29 8	11 7	12 1	2 2	1 6	W.	2	W.	2	fair	fair	— —
7	29 6	29 5	12 4	13 1	2 2	2 0	S. w.	3	W.	3	clou	vari	— —
8	29 7	29 9	11 5	10 7	1 5	1 3	W.	3	N.	3	clea	clea	— —
9	30 0	30 0	9 4	11 2	1 3	1 4	N.	2	W.	1	miſt	clou	— —
10	29 7	29 6	12 6	13 0	2 3	2 0	W. *b* S.	2	W.	2	clou	clou	— —
11	29 8	29 9	10 0	10 7	1 4	1 5	N. e.	2	E. *b* n.	1	clea	clea	— —
12	30 0	30 0	10 6	10 5	1 6	1 5	S. e.	2	S. e.	2	clou	clea	— —
13	29 8	29 7	10 2	11 5	1 7	1 5	S. e.	1	S. e.	1	fair	fair	— —
14	29 6	29 5	11 6	12 2	2 5	2 5	S. e.	1			fair	rain	0 025
15	29 5	29 5	11 9	12 4	2 3	1 6	W.	1	W.	1	fair	clea	0 259
16	29 5	29 5	11 2	12 1	2 2	1 7	S. w.	1	S. w.	1	fair	rain	0 060
17	29 4	29 5	13 7	13 2	1 8	1 8	S. w.	3	S. w.	1	clou	clou	— —
18	29 7	29 7	12 4	13 2	2 0	2 0	S. w.	1	S.	0	clea	clou	— —
19	29 6	29 8	11 7	11 6	1 9	1 6	S. *b* e.	3	S.	1	fair	fair	0 062
20	29 9	29 9	10 7	11 4	1 9	2 0	S. *b* e.	1	S. *b* e.	0	clou	clou	0 045
21	29 9	29 8	11 4	11 4	2 0	1 9	S. *b* e.	1	S. *b* e.	1	clou	clou	— —
22	29 8	29 8	10 3	11 3	1 9	1 8	S. *b* w.	1	S. *b* w.	1	fair	fair	0 009
23	29 6	29 5	11 2	12 1	1 7	1 8	S.	2	S.	2	clou	rain	— —
24	29 7	29 7	10 3	11 4	2 0	1 9	S.	1	S.	1	clea	clou	
25	29 6	29 5	11 5	11 4	2 3	2 0	S.	1	S.	1	clou	clou	
26	29 5	29 4	11 5	12 0	2 2	2 1	S.	1	S. e.	1	fog	clou	0 085
27	29 5	29 6	11 7	11 4	2 4	2 7	S. w.	1	E.	1	rain	rain	
28	29 7	29 7	12 5	12 0	3 7	3 4	N. e.	2	S. e.	1	miſt	clou	0 246
29	29 6	29 5	12 1	12 2	3 1	3 0	S. e.	1	S. e.	1	clou	clou	0 010
30	29 3	28 9	11 8	11 9	2 8	2 7	S. e.	2	S. e.	3	clou	clou	
31	28 8	28 8	10 5	10 1	2 4	2 3	S. *b* w.	1	S. w.	1	rain	clou	0 196

Total Depth 1, 479

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 3	11 7	2 0
Greateſt Height ———	30 0	14 3	3 4
Leaſt Height ———	28 8	10 8	1 3

NOVEMBER, 1731.

Day.	Barom.		Thermom		Hygrofc.		Wind.				Weath.		Rain.
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^n.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af	In. D.
1	28 8	28 9	8 7	9 3	2 4	2 4	S. w.	1	S. w.	1	clea	clea	0 273
2	28 9	29 1	9 2	9 0	2 5	2 4	W.	2	W.	2	clou	clea	— —
3	29 1	29 2	9 5	10 4	2 5	2 4	W.	2	W.	2	clea	clou	
4	29 2	29 3	10 6	10 5	2 1	2 0	W.	3	W.	2	clea	clea	0 025
5	29 4	29 3	10 0	10 2	2 3	2 3	W.	2	W.	2	clou	clou	0 034
6	29 7	29 2	8 5	9 0	2 4	2 0	W.	2	N. w.	2	clea	clea	— —
7	29 3	29 4	8 4	8 6	2 0	2 0	N. w.	1	N. w.	1	clea	clea	— —
8	29 4	29 3	8 6	9 2	2 2	2 2	N.w.*b*n.	1	N. e.	1	mift	clea	— —
9	29 3	29 3	9 9	9 9	2 4	2 4	E.	2	E.	2	clou	clou	0 093
10	29 4	29 4	10 1	10 1	2 5	3 0	N. e.	3	N. e.	3	rain	rain	0 254
11	29 6	29 7	10 0	10 2	3 8	3 4	N. e.	2	N. e.	2	clou	clou	
12	29 6	29 5	10 0	10 6	3 1	2 6	S. w.	2	W.	2	clou	clou	0 286
13	29 7	29 7	9 7	10 6	2 8	2 6	W.	1	W.	1	clea	clou	— —
14	29 5	29 6	12 3	12 6	2 8	2 9	W.	3	W.	3	clou	clou	— —
15	29 8	29 9	12 0	12 2	3 0	2 9	W.	3	W.	1	clea	clou	— —
16	30 0	29 9	11 1	11 8	2 9	2 8	W.	1	W. *b* f.	1	fog	clou	— —
17	29 8	29 7	11 5	11 8	2 8	2 7	S. w.	1	S. w.	1	clou	clou	— —
18	28 0	29 8	11 6	12 0	2 8	2 6	W.	2	W.	2	clea	clou	
19	29 5	29 4	10 9	10 6	2 5	2 2	W.	3	W.	3	clou	clou	
20	29 8	29 9	9 1	9 9	2 0	2 0	N. w.	1	W.	1	clea	clou	0 021
21	29 9	29 8	11 2	11 1	2 1	2 0	W.	2	W.	2	clea	clea	
22	29 6	29 6	10 3	10 3	2 1	2 0	W.	3	W.	3	clea	clou	
23	29 5	29 5	8 9	9 5	2 3	2 1	W.	2	W.	3	clea	clou	0 203
24	29 7	29 8	8 4	8 8	2 0	2 0	N. w.	2	N. w.	3	clou	clou	
25	29 9	29 9	7 8	8 6	2 0	1 9	N. w.	2	N. w.	2	froft	fair	— —
26	30 1	30 1	7 4	8 3	1 9	1 4	N. w.	2	N. w.	2	froft	fair	
27	30 3	30 3	8 0	8 4	1 2	2 2	W.	1	W.	1	froft	clou	
28	30 1	30 0	9 2	9 2	2 1	2 1	S. e.	1	E.	1	fair	fair	
29	29 6	29 5	9 2	9 2	2 2	2 3	E.	1	E. *b* f.	1	fog	fog	
30	29 5	29 5	9 4	9 5	2 0	2 1	S. w.	2	S. w.	2	clou	clou	0 233

Total Depth 1, 422

	Barom.	Ther.	Hygr.
	In. D.	In. D.	In. D.
Height at a Medium	29 8	09 8	2 3
Greateft Height	30 3	12 6	3 8
Leaft Height	28 0	07 4	1 2

DECEMBER, 1731

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon.		Wind. Afternoon.		Weath.		Rain.
	I. D.	I. D	I. D	I. D.	I. D.	I. D	Direct.	fo.	Direct	fo.	Fo	Af.	In. D.
1	29 8	29 8	8 2	9 1	2 3	2 0	W. *b* f.	1	W. *b* f.	1	clea	clea	0 075
2	29 9	29 9	9 8	11 0	2 4	2 5	S. w.	2	S. w.	3	clou	clou	— —
3	29 6	29 6	9 9	10 2	2 4	2 1	W.	3	W.	3	clea	clea	— —
4	29 5	29 5	9 0	9 9	2 6	2 4	W.	2	W.	2	fog	fog	
5	29 3	29 2	11 7	11 4	2 9	2 3	W.	4	W.	4	clou	clea	
6	29 4	29 4	9 4	9 7	2 2	2 2	W.	2	W.	2	clea	clea	0 062
7	28 9	29 0	8 9	8 5	3 5	3 4	N.	3	N.	2	rain	fair	
8	29 4	29 5	7 3	7 6	2 3	2 3	W.	2	W.	2	froſt	froſt	
9	29 3	29 0	8 3	9 4	2 3	2 4	S. e.	3	S.	3	ſtor	ſtor	1 175
10	29 2		10 2		2 2		W.	3			clou		— —
11	29 7	29 8	10 6	11 2	2 6	2 5	S. w.	2	W.	2	clou	clea	
12	29 6	29 6	10 3	9 3	2 1	2 2	W.	4	W.	4	low	clou	0 173
13	29 4	29 4	10 9	11 4	2 4	2 1	W.	3	W.	3	clou	clou	— —
14	29 5	29 7	9 4	9 3	1 7	1 8	N. w.	4	N. w.	3	clea	fair	0 081
15	29 9	29 8	7 8	8 8	1 8	1 7	S.	1	S.	1	froſt	clou	0 030
16	29 6	29 6	9 2	9 8	2 4	2 3	W.	1	W.	1	clea	clea	0 070
17	29 3	29 2	9 5	8 8	2 3	2 4	S. w.	1	W.	1	clou	ſno	
18	29 4	29 3	8 8	9 3	2 5	2 0	N.	3	N.	2	rain	clou	0 092
19	29 8	29 8	8 3	9 0	2 0	2 0	N.	2	N.	2	clou	clou	— —
20	29 8	29 8	8 5	8 8	2 4	2 1	N. w.	1	N. w.	1	clou	clea	
21	30 0	30 0	7 5	8 5	2 2	2 3	W.	1	W.	2	froſt	clea	0 237
22	30 1	30 2	8 8	9 3	2 9	2 8	E.	1	E.	2	fog	clea	
23	29 9	29 9	8 7	8 8	2 5	2 6	S. e.	1	S. e.	1	fog	clea	
24	29 8	29 7	8 3	8 4	2 8	2 5	N.	2	N. w.	2	clou	clea	
25	29 9	29 8	8 8	9 2	2 5	2 6	W.	2	N. w.	2	rain	clou	1 027
26	29 6	29 5	6 7	6 8	2 0	2 1	W.	2	N. w.	2	froſt	ſno	— —
27	29 4	29 4	6 3	6 3	1 9	1 9	W.	2	W.	2	clea	clea	
28	29 5	29 5	5 7	6 9	2 1	2 0	W.	2	W.	2	froſt	clou	0 080
29	29 1	29 1	7 6	9 2	2 8	3 2	W.	1	W.	1	ſno	clou	— —
30	29 2	29 3	10 9	11 5	3 0	2 8	S. w.	2	S.	3	clou	clou	
31	29 7	29 7	11 3	11 4	2 6	2 3	S. w.	1	S. w.	1	clou	fair	0 023

Total Depth 3, 125

	Barom. In. D.	Ther In. D.	Hygr. In. D.
Height at a Medium ———	29 5	9 0	2 3
Greateſt Height ———	30 2	11 7	3 5
Leaſt Height ———	28 9	5 7	1 7

JANUARY, 1732.

Day.	Barom. For^n. I. D	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D	Hygroſc. For^n. I. D.	Hygroſc. Aft^n. I. D.	Wind. Forenoon Direct.	Forenoon fo.	Wind. Afternoon. Direct.	Afternoon fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 8	29 8	10 3	10 5	1 8	1 9	E.	1	S. e.	2	fair	fair	0 035
2	30 0	30 0	8 9	9 1	2 5	2 6	S. e.	2	S. e.	2	fog	fog	— —
3	30 1	30 1	8 4	8 6	2 5	2 4	S. e.	2	S. e.	2	fog	clea	— —
4	30 2	30 2	8 6	9 0	2 2	2 2	S. e.	1	S. e.	1	fog	fog	
5	30 2	30 2	9 3	9 1	3 4	3 2	E.	2	N. e.	2	miſt	clou	0 023
6	30 0	29 9	9 3	9 4	3 5	3 0	N. e.	2	N. e.	2	rain	clea	
7	29 6	29 5	8 4	8 3	2 3	3 0	W.	2	W.	2	clou	ſno	
8	29 3	29 3	7 5	7 7	2 3	2 2	W.	2	W. *b* n.	2	froſt	froſt	
9	29 4	29 4	7 2	7 8	2 2	2 4	W.	2	W.	2	froſt	clou	0 071
10	29 7	29 8	6 8	7 4	2 1	2 0	W.	2	W.	1	froſt	froſt	— —
11	29 7	29 7	7 5	8 4	2 4	2 5	S. e.	2	S. e.	2	fair	clou	— —
12	29 7	29 8	8 5	9 2	2 9	2 8	S. e.	2	S. e.	2	fog	clou	
13	29 7	29 7	8 2	8 2	2 8	2 8	S. *b* e.	2	S. *b* e.	2	fog	fog	
14	29 7	29 7	6 9	7 7	2 8	2 5	S.	2	S.	2	froſt	froſt	0 173
15	29 5	29 5	6 9	8 1	3 0	3 2	S. e.	1	S. e.	2	froſt	fog	
16	29 4	29 3	7 7	8 5	3 2	2 5	S. e.	2	S. e.	2	froſt	fog	0 083
17	29 0	29 0	8 9	9 1	2 8	3 0	E.	2	E.	2	fog	rain	
18	29 1	29 2	8 7	8 6	3 8	3 5	N. e.	3	N. e.	3	fog	rain	
19	29 4	29 5	8 0	8 4	2 5	2 3	E.	2	E.	2	ſno	fair	
20	29 7	29 7	7 0	7 6	2 2	2 2	W.	2	W.	2	froſt	froſt	0 158
21	29 8	29 7	7 2	8 1	2 2	2 2	W.	2	W.	2	froſt	froſt	
22	29 7	29 7	9 0	9 1	2 8	2 6	W.	2	W.	2	freſ	freſ	0 035
23	29 7	29 7	8 7	9 0	2 5	2 5	W.	2	W.	1	fair	fair	— —
24	29 7	29 6	8 5	9 6	2 6	2 5	S.	2	S.	2	fair	fair	0 120
25	29 4	29 4	11 0	11 4	2 5	2 5	S.	3	S. w.	3	rain	rain	
26	29 3	29 2	11 4	11 5	2 5	2 3	S. w.	2	S. w.	3	clou	clou	
27	29 1	29 1	10 2	10 8	2 3	2 2	S. *b* w.	2	S.	2	fair	fair	0 289
28	28 9	29 0	9 8	10 6	2 7	2 6	S. e.	1	S. w.	2	rain	fair	0 052
29	29 1	29 1	9 3	10 3	2 5	2 4	S. e.	2	S. e.	2	fair	clou	
30	29 3	29 4	9 9	10 2	2 8	2 7	S. w.	2	S. w.	2	clou	clou	
31	29 5	29 5	10 4	11 5	2 6	2 3	S. *b* w.	2	S. *b* w.	2	clou	fair	0 244

Total Depth 1, 283

	Barom. In. D.	Ther. In. D.	Hygr. I D.
Height at a Medium ———	29 3	8 8	2 5
Greateſt Height———	30 2	11 5	3 8
Leaſt Height ———	28 9	6 8	1 8

FEBRUARY, 1732.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 6	29 7	11 6	11 3	2 5	1 8	S. w.	2	S. w.	2	clou	clou	0 053
2	29 7	29 6	11 0	11 8	2 1	2 1	S. *b* w.	2	S. *b* w.	3	fair	fair	0 027
3	29 6	29 6	11 9	12 5	2 2	2 2	S. w.	2	S. w.	3	fair	fair	0 063
4	29 5	29 4	12 0	12 4	2 3	2 2	S. w.	3	S. w.	3	rain	clou	— —
5	29 6	29 6	10 1	9 9	2 7	3 0	E.	1	E.	1	rain	clou	0 205
6	29 6	29 0	10 9	11 3	2 6	2 5	W.	2	W.	3	clou	clou	0 110
7	29 0	28 8	8 6	9 8	2 2	2 5	S. e.	2	W.	3	ſno	fair	0 197
8	28 7	29 0	9 0	8 9	2 6	2 3	N. e.	1	N.	2	fair	fair	
9	29 4	29 3	9 2	10 9	2 2	2 4	S.	3	S. w.	3	clou	clou	0 262
10	29 4	29 5	9 9	10 6	2 3	2 0	S. w.	3	W.	2	clou	fair	0 402
11	28 9	29 2	9 6	9 7	2 3	2 2	W.	3	W.	3	clou	clou	0 145
12	29 4	29 6	9 1	10 0	2 2	1 8	W.	2	W.	2	clea	clou	
13	30 1	30 2	8 9	10 1	2 0	1 8	S. w.	1	S. *b* w.	2	clou	clou	0 088
14	29 9	29 8	10 7	12 0	2 2	2 0	S. w.	3	S. w.	3	clou	clou	
15	29 8	29 8	10 6	11 8	2 6	2 3	W.	2	W.	2	clea	clou	0 209
16	29 6	29 6	11 6	11 3	2 0	1 8	W.	2	W.	3	fair	fair	— —
17	29 8	29 9	9 8	11 2	2 4	2 0	W.	2	W.	3	fair	clou	— —
18		29 8		12 8		2 1			S. w.	2		fair	
19	29 8		11 6		2 2		S. w.	1			fair		
20		29 5		11 7		1 7			S. w.	3		fair	
21	29 1	29 1	11 3	10 8	1 9	1 5	S. w.	3	S. w.	3	clou	clou	
22	29 3	29 4	9 2	9 4	2 1	1 9	W.	2	W.	2	clea	clea	0 315
23		29 5		9 9		1 7			W.	2		clea	
24		29 6		10 8		1 5			S.	2		clea	
25	29 3	29 3	9 3	9 4	1 7	1 5	W.	3	W.	3	ſno	clea	0 194
26	29 3	29 3	9 4	12 2	2 0	2 2	S.	3	W.	3	rain	clou	0 062
27	29 5	29 4	11 5	12 0	1 8	2 0	S. w.	3	S. w.	4	clou	rain	— —
28	29 6	29 7	9 4	10 2	2 0	1 7	S. w.	3	W.	2	clea	clea	0 077
29	29 8	29 8	9 5	10 7	1 9	1 5	W.	2	W.	1	clea	clea	

Total Depth 2, 409

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ——	29 4	10 4	2 1
Greateſt Height ——	30 2	12 8	3
Leaſt Height ——	28 7	8 6	1 5

MARCH, 1732.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 4	29 4	10 8	10 2	1 8	2 6	S. w.	4	W.	3	ſtor	rain	0 067
2	29 3	29 3	9 1	9 3	2 3	1 8	W.	3	W.	2	clea	clea	0 032
3	29 3	30 1	9 1	9 4	1 5	1 4	N. w.	4	N. w.	2	clea	clea	0 015
4	30 1	29 9	8 9	10 9	1 7	1 9	W.	2	W.	2	clou	clou	— —
5	29 7	29 6	11 2	11 7	2 4	2 4	W.	2	W.	2	clou	clou	— —
6	29 6	29 6	11 0	10 8	2 4	1 6	W.	1	N. w.	2	clea	rain	
7	29 8	30 0	9 8	10 6	1 9	1 6	N. w.	1	E.	1	clea	clea	0 021
8	29 9	29 7	10 0	10 5	1 9	1 8	E.	1	W. *b* n.	2	fair	fair	— —
9	29 5	29 4	10 1	9 2	1 8	1 9	W. *b* n.	2	N.	2	fair	vari	— —
10	29 4	29 4	7 7	7 8	1 5	1 4	N. w.	3	N. w.	3	ſno	clea	
11	29 4	29 4	7 7	7 8	1 4	1 4	N. w.	3	N.	2	clou	clea	0 039
12	29 4	29 4	7 6	8 8	1 3	1 2	W.	2	S. w.	2	clea	clou	
13	29 2	29 3	9 4	9 5	2 2	1 5	W.	2	N. e.	1	clou	clea	
14	29 3	29 2	9 8	10 7	2 7	1 7	S. w.	2	S. w.	1	clou	clou	0 102
15	29 2	29 3	10 1	11 0	2 1	1 8	S. w.	1	N.	1	fog	clea	
16	29 6	29 6	10 6	10 5	2 2	2 1	E.	1	E.	1	fog	rain	
17	29 6	29 7	10 4	11 7	2 2	2 4	E.	1	S. w.	1	clou	clou	0 024
18	29 6		11 4		2 0		S. w.	1				rain	0 056
19	29 6	29 7	12 5	13 4	2 3	1 8	W.	2	W.	1	clou	clou	
20	29 8	29 8	12 9	13 6	2 0	1 8	W.	1	W.	1	clea	clou	
21	29 8	29 8	12 3	13 6	2 3	2 0	W.	1	W.	1	fog	clou	0 015
22	29 9	29 9	12 1	12 6	2 2	1 6	W.	2	W.	2	clea	clou	
23	29 9	29 9	12 4	13 4	1 7	1 4	S. w.	2	W.	2	clou	clou	
24	29 9	29 9	13 0	13 0	1 7	1 7	W.	2	W.	2	clou	fair	0 031
25	29 9	29 8	10 7	10 5	1 5	1 2	W.	3	N. w.	3	fair	fair	
26	29 7	29 7	9 5	10 1	1 5	1 3	N. w.	3	N. w.	3	clou	hail	0 050
27	29 6	29 6	9 0	9 0	1 5	1 8	N. w.	2	N.	1	fair	ſno	0 030
28	29 6	29 5	9 4	9 7	1 8	1 4	E.	1	E.	1	ſno	fair	
29	29 5	29 5	9 4	9 5	1 7	1 4	E.	2	E.	1	fair	fair	0 138
30	29 6	29 5	9 7	9 7	1 5	1 5	E.	2	E.	3	clou	clou	
31	29 5	29 5	9 9	9 9	3 0	3 4	E.	2	E.	2	rain	rain	0 173

Total Depth 0, 793

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	10 4	1 8
Greateſt Height	30 1	13 6	3 4
Leaſt Height	29 2	7 6	1 2

APRIL, 1732.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygroſc. For^n.	Hygroſc. Aft^n.	Wind Forenoon Direct.	fo.	Wind Afternoon Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 5	29 5	9 8	9 9	3 4	3 3	E.	2	E.	2	fog	fog	0 193
2	29 6	29 6	10 3	10 9	3 4	2 4	E.	2	E.	1	fog	fog	0 095
3	29 6	29 5	10 9	12 7	2 7	2 0	S. e.	1	S.	1	clou	clou	0 070
4	29 3	29 3	11 9	12 4	2 3	1 9	S.	1	S. w.	2	rain	fair	
5	29 4	29 5	11 7	13 2	1 9	1 6	S. w.	2	S. w.	1	fair	fair	0 082
6	29 7	29 7	10 6	10 9	3 0	2 9	E.	2	E.	2	miſt	miſt	
7	29 7	29 7	10 2	10 8	3 6	3 5	E.	2	E.	2	miſt	miſt	
8	29 7	29 7	10 5	11 6	3 8	2 9	E.	2	E.	2	miſt	miſt	0 097
9	29 8	29 9	10 6	10 8	3 6	3 3	E.	2	E.	2	miſt	miſt	
10	30 0	30 0	10 4	11 0	3 3	2 5	E. *b* n.	2	E.	2	haz	haz	
11	29 9	29 8	10 5	10 9	2 5	2 2	N. e.	3	N. e.	2	vari	fair	0 030
12	29 6	29 5	10 6	11 9	2 5	1 8	S. w.	2	N. e.	2	clea	clou	
13	29 6	29 6	9 3	9 5	1 6	1 5	N. w.	3	N. w.	3	clou	ſno	0 350
14	29 5	29 5	9 1	9 6	1 4	1 4	N. w.	3	N. w.	3	clou	clou	
15	29 5	29 5	9 9	10 9	1 3	1 2	N. w.	3	N. w.	2	clea	clou	0 105
16	29 5	29 6	9 0	10 7	1 3	1 1	N. w.	2	N. *b* w.	2	clea	clou	
17	29 7	29 7	10 2	11 3	1 3	1 2	N. *b* e.	2	N. w.	1	clea	clea	
18	29 7	29 7	10 8	11 8	1 3	1 4	N. w.	1	S. e.	2	clea	clou	0 131
19	29 7	29 7	10 6	10 1	1 5	1 9	S. e.	2	E.	2	rain	rain	
20	29 7	29 6	10 5	10 8	2 4	2 0	E.	2	E.	1	clou	clou	0 119
21	29 6	29 6	11 8	12 4	2 7	2 4	E.	1	E.	1	fog	rain	0 152
22	29 5	29 5	12 4	12 5	2 3	2 2	W.	1	S. w.	1	clou	rain	0 209
23	29 5	29 2	11 4	11 8	2 9	2 5	S. e.	1	S. e.	1	rain	rain	
24	29 1	29 2	12 4	13 4	2 1	1 6	S.	1	S. *b* w.	2	clou	clea	0 568
25	29 3	29 4	12 7	13 0	2 1	1 8	S.	2	E.	2	rain	rain	0 154
26	29 7	29 7	10 2	11 2	2 3	1 7	E.	2	E.	2	clea	clea	0 074
27	29 8	29 8	10 6	12 5	1 7	1 4	N. e.	2	N. e.	1	clea	clou	— —
28	29 7	29 6	12 0	10 0	1 6	1 6	W.	2	N. w.	2	clou	rain	0 058
29	29 6	29 6	11 2	10 0	2 0	2 2	N. e.	2	N. w.	3	clou	hail	0 262
30	29 6	29 5	9 8	10 7	1 5	1 6	W. *b* n.	3	W. *b* n.	3	clou	rain	0 357

Total Depth 3, 106

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 5	10 8	2 1
Greateſt Height	30	13 2	3 8
Leaſt Height	29 1	9	1 1

MAY, 1732.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo	Weath. Af.	Rain. In. D.
1	29 5	29 4	9 5	9 1	2 5	2 5	S. e.	2	N. e.	2	clou	rain	0 327
2	29 5	29 5	9 3	10 7	1 6	1 3	W.	2	W. *b* n.	2	clea	clea	0 255
3	29 6	29 6	9 8	11 6	1 4	1 1	W. *b* n.	2	W. *b* n.	2	clea	clea	0 093
4	29 6	29 6	10 6	10 8	1 5	1 4	N. w.	2	N. w.	2	clea	clea	— —
5	29 6	29 6	10 1	11 8	1 4	1 1	N. *b* e.	2	N.	2	clou	clea	
6	29 8	29 8	11 1	12 0	1 3	1 0	N.	2	N. e.	2	clea	clea	
7	29 9	29 8	11 9	13 5	1 1	1 0	S. e.	2	S. e.	2	clea	clea	
8	29 6	29 5	11 8	12 9	1 6	1 7	E.	2	S.	2	clou	rain	— —
9	29 6	29 5	12 6	12 8	1 5	1 5	S. w.	2	S. e.	2	clou	rain	0 099
10	29 4	29 4	12 7	12 6	1 6	1 5	S.	2	S.	2	clou	rain	
11	29 3	29 3	12 4	13 9	1 5	1 0	S. w.	3	S. w.	3	clou	clea	0 173
12	29 2	29 3	12 7	12 5	1 5	1 5	W.	3	W.	3	clea	rain	0 237
13	29 5	29 5	12 2	12 7	1 4	1 5	W.	2	S.	2	clou	rain	0 192
14	29 4	29 4	13 7	13 5	2 0	1 5	S. w.	2	S. w.	3	clou	rain	0 125
15	29 5	29 5	13 5	13 4	1 6	1 4	S. w.	2	S.	3	clou	clou	0 157
16	29 5	29 6	13 2	14 3	1 4	1 3	S. w.	2	N. e.	2	clou	clou	— —
17	29 9	29 9	10 0	11 3	1 2	1 5	E. *b* n.	3	E.	2	rain	clou	0 298
18	29 9	29 9	10 9	11 1	1 7	1 5	N. w.	2	N. w.	2	clou	clea	0 064
19	29 8	29 7	10 5	11 1	1 3	1 3	N. w.	2	N. w.	2	clou	hail	0 313
20	29 6	29 7	10 5	11 8	1 5	1 5	N.	1	E.	1	clou	clou	0 279
21	29 7	29 7	11 5	13 1	1 4	1 4	S.	1	S. e.	1	clea	clou	
22	29 7	29 7	12 2	13 0	2 2	2 1	W.	2	W. *b*. n.	2	rain	rain	0 411
23	29 5	29 4	11 9	12 8	2 5	2 0	E. *b* f.	1	E. *b* f.	2	clou	clou	0 195
24	29 4	29 4	12 5	12 9	2 5	2 2	S.	2	E.	2	rain	rain	0 177
25	29 4	29 4	11 9	12 6	2 9	2 0	E. *b* f.	2	E.	1	clou	clou	0 305
26	29 5	29 4	11 8	12 8	2 5	1 9	E.	1	E.	2	clou	clou	0 392
27	29 1	29 0	12 5	13 7	3 0	1 8	E.	2	S.	1	clou	clou	0 185
28	29 0	29 1	13 2	14 0	1 9	1 5	S.	2	S.	2	clou	clou	0 140
29	29 2	29 3	13 5	14 5	1 7	1 3	S.	2	S.	2	clea	clea	0 061
30	29 5	29 5	13 4	14 6	1 8	1 7	S. w.	2	S. w.	2	rain	clou	0 094
31	29 5	29 5	12 6	14 6	2 0	1 3	S. e.	2	W.	2	clou	clea	0 055

Total Depth 4, 627

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 5	12 2	1 6
Greatest Height	29 9	14 6	3 0
Least Height	29	9 1	1 0

JUNE, 1732.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 6	29 6	13 0	14 0	1 5	1 3	W.	2	N. e.	1	clea	clea	— —
2	29 8	29 8	13 0	14 4	1 4	1 1	N. w.	2	N. w.	2	clea	clea	0 043
3	30 0	30 0	13 3	14 9	1 3	1 0	W.	2	N. w.	2	clea	clea	
4	30 0	29 9	13 5	15 7	1 5	0 7	N. w.	2	S. w.	2	clea	clea	
5	29 9	29 9	15 4	15 4	1 0	1 0	S. w.	2	S. w.	1	clea	clou	
6	29 9	29 9	14 6	14 6	1 0	0 8	W.	2	W.	2	clea	clea	
7	29 9	29 8	14 7	14 8	1 0	0 9	W.	1	N. e.	1	clou	clea	
8	29 8	29 7	13 7	15 2	1 5	1 0	E.	2	E.	2	clea	clea	
9	29 7	29 6	13 3	14 1	1 3	1 3	E.	2	E.	2	clea	clea	
10	29 6		13 2		2 0		N. e.	1			clou		
11	29 7	29 7	13 0	13 4	1 9	1 2	N. e.	2	N. e.	2	clou	clea	
12	29 7	29 7	13 4	14 6	1 4	1 3	W.	2	W.	2	clea	rain	
13	29 6	29 6	13 1	12 7	3 1	1 6	N. e.	2	N. e.	2	clou	clea	0 615
14	29 6	29 6	12 0	13 6	2 0	1 4	N.	2	N. w.	2	clou	clou	0 052
15	29 6	29 6	12 9	13 7	1 6	1 3	W.	2	W.	2	clou	clea	
16	29 6	29 6	12 3	14 5	2 0	1 3	N. w.	2	W.	2	rain	clea	0 167
17	29 7	29 7	13 4	14 7	1 4	1 5	W.	2	W.	2	clou	rain	
18	29 8	29 8	13 5	14 5	1 5	1 2	W.	2	W.	2	clou	clea	
19	29 7	29 6	13 8	13 3	1 7	2 0	S. w.	1	E.	1	rain	rain	
20	29 5	29 4	13 2	14 5	1 7	1 2	W.	2	W.	2	clea	clea	0 244
21	29 4	29 4	13 7	13 8	1 4	1 5	W.	2	W.	1	clou	low	
22	29 5	29 6	13 4	14 4	1 7	1 5	N. w.	1	N. e.	1	clea	clou	
23	29 8	29 8	14 1	14 5	1 7	1 4	N. e.	1	N. e.	1	clou	clea	
24	30 0	30 1	14 2	14 3	1 5	1 5	E.	2	E.	2	clea	clea	0 075
25	30 2	30 2	14 7	14 7	1 7	1 6	E.	2	E.	1	low	clea	
26	30 3	30 3	13 9	15 4	2 4	1 5	E.	2	E.	2	fog	clea	
27	30 3	30 3	15 0	15 9	1 4	1 3	E.	2	E.	2	clea	clea	
28	30 3	30 2	14 3	15 5	2 3	1 6	E.	2	E.	2	low	clea	
29	30 1	30 0	14 6	15 0	1 8	1 4	W.	2	W.	2	low	clea	
30	30 0	30 0	14 7	15 6	1 5	1 2	W.	2	W.	2	clea	clou	— —

Total Depth 1, 196

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	14 1	1 4
Greatest Height	30 3	15 9	3 1
Least Height	29 4	12 0	0 7

JULY, 1732.

Day.	Barom.		Thermom.		Hygrofc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	30 1	30 1	14 4	15 5	1 7	1 2	N. w.	2	N. w.	1	clou	clea	0 045
2	30 0	29 8	15 0	15 3	1 3	1 2	N. w.	2	W.	3	clea	low	
3	29 6	29 7	13 4	13 7	1 4	1 0	W.	3	N.	2	clea	clea	
4	29 7	29 7	12 5	14 3	1 1	0 9	W.	3	N. w.	2	clea	clea	
5	29 8	29 8	13 0	15 3	1 1	1 1	N. w.	1	N. w.	1	clea	clea	
6	29 8	29 8	14 4	15 5	1 8	1 3	W.	1	W.	2	low	fog	
7	29 6	29 6	15 2	16 1	1 6	1 4	S. w.	3	S. w.	2	low	low	
8	29 4	29 5	15 4	15 1	1 3	1 0	S. w.	3	S. w.	3	low	clea	
9	29 5	29 4	14 4	15 1	1 4	1 2	S. w.	1	S. w.	1	low	low	
10	29 3	29 2	13 4	12 7	1 6	1 8	S. w.	2	E.	2	clea	g.ra	
11	29 3	29 3	12 3	13 9	2 5	1 3	W.	2	W.	2	low	clea	0 685
12	29 4	29 4	13 3	13 7	1 7	1 6	W.	1	N. e.	1	clea	clea	0 193
13	29 3	29 3	11 7	12 6	3 2	3 6	N. e.	1	N. e.	2	clea	clou	
14	29 4	29 5	12 7	13 2	3 1	2 9	S. e.	2	S. e.	2	clou	clou	0 367
15	29 7	29 8	13 6	15 2	2 2	2 0	S. e.	2	S.	2	rain	low	
16	29 9	29 9	14 8	15 4	2 0	1 7	S.	1	E.	0	low	clea	
17	29 9	29 9	14 3	15 3	1 8	1 6	N. w.	1	N. w.	2	clea	clea	
18	29 9	29 9	13 4	14 3	1 6	1 6	N. w.	2	N. e.	2	clea	clou	
19	29 9	29 9	13 5	14 7	1 9	1 5	N. e.	2	N. e.	2	clea	clea	
20	29 9	29 8	13 8	14 7	1 7	1 6	W.	2	W.	2	clea	clou	
21	29 6	29 5	14 3	15 4	2 1	1 8	S. w.	2	W.	2	rain	clou	0 632
22	29 6	29 6	12 6	13 7	3 0	2 5	W.	2	E.	2	low	low	0 140
23	29 2	29 5	12 4	12 5	3 3	2 3	N.	3	N. w.	2	g.ra	clea	
24	29 6	29 7	12 3	13 6	2 2	1 7	N. *b* w.	2	W. *b* n.	2	clea	clea	0 273
25	29 8	29 8	13 0	14 2	1 9	1 5	W. *b* n.	2	N. e.	1	clea	clea	
26	29 8	29 8	13 3	13 4	1 6	1 6	N. w.	2	N.	1	clea	clou	0 642
27	29 7	29 7	13 0	14 9	1 8	1 5	N.	1	S. w.	1	clea	clou	
28	29 7	29 7	13 9	14 3	1 5	1 3	W.	2	W.	2	clea	clea	0 157
29	29 8	29 8	13 9	14 4	1 6	1 2	W. *b* n.	2	W.	1	clea	clou	0 026
30	29 7	29 7	14 3	14 3	2 5	2 5	W. *b* n.	2	W. *b* n.	2	clou	clou	
31	29 6	29 7	13 6	14 2	1 4	1 1	W. *b* n.	2	N. w.	1	clea	clea	0 039

Total Depth 3, 199

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	13 9	1 7
Greatest Height	30 1	16 1	3 6
Least Height	29 2	11 7	0 9

AUGUST, 1732.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D	Direct.	fo.	Direct·	fo.	Fo.	Af.	In. D.
1	29 8	29 8	13 0	13 9	1 2	1 1	N. w.	0	N. e.	1	clea	clea	— —
2	29 9	29 9	13 1	14 1	1 6	1 2	S. w.	1	N.	1	clea	clea	— —
3	30 0	30 0	13 5	14 8	1 5	1 3	N. w.	1	N.	1	clea	clea	— —
4	30 0	30 0	13 7	14 9	1 6	1 1	S.	1	S. e.	1	clea	clea	— —
5	30 0	29 9	13 9	15 6	1 5	1 1	S. e.	1	S. e.	0	clea	clea	— —
6	30 0	30 0	13 7	14 4	2 5	1 8	E.	1	E.	1	clou	clea	
7	29 9	29 9	13 8	15 0	2 3	1 7	S. e.	0	S. e.	1	fog	clea	
8	29 8	29 6	13 0	14 6	2 5	1 4	W.	1	W.	2	low	clea	
9	29 5	29 5	13 2	13 6	2 0	1 9	W.	2	E.	0	clou	clou	
10	29 5	29 5	12 2	13 3	1 7	1 1	N. w.	2	N. w.	2	clou	clou	
11	29 6	29 7	11 9	11 5	1 4	1 4	N. w.	2	E.	2	clou	clou	
12	29 5	29 4	12 0	12 9	1 4	1 5	S. w.	0	W.	1	clou	low	0 365
13	29 3	29 3	12 5	12 0	2 0	3 1	N. e.	1	N. e.	2	low	g. ra	
14	29 5	29 5	11 7	12 7	3 4	2 0	N. e.	1	N. w.	1	clou	clea	
15	29 6	29 5	12 0	13 2	2 1	1 5	W. *b* f.	2	W.	2	clea	clea	
16	29 6	29 6	12 1	13 4	1 7	1 3	W. *b* f.	1	W.	2	clea	clea	
17	29 7	29 7	12 3	14 0	1 7	1 2	N. w.	1	W.	1	clea	clou	
18	29 7	29 6	13 5	14 9	1 6	1 6	S. w.	2	S.	2	clea	clou	
19	29 5	29 5	14 0	14 3	1 9	1 5	N. w.	2	W. *b* n.	2	clou	clea	
20	29 6	29 5	13 6	14 0	2 0	2 0	S. w.	1	S.	2	rain	clou	0 432
21	29 4	29 5	14 5	15 0	1 8	1 6	S. w.	2	S. w.	2	clou	clea	
22	29 7	29 7	12 2	12 7	1 8	1 5	N. e.	2	E. *b* n.	2	clou	clea	
23	29 6	29 5	12 4	13 5	1 8	1 7	E.	1	S. w.	0	rain	rain	
24	29 8	29 9	12 5	13 7	2 1	1 3	W.	2	W.	2	clea	clea	
25	29 9	29 8	13 5	14 2	1 5	1 5	S. w.	1	S. w.	2	clea	rain	
26	29 7	29 7	14 6	13 6	1 7	2 0	S. w.	2	W.	2	clou	rain	
27	29 9	30 0	12 6	13 7	1 8	1 2	W. *b* n.	2	W. *b* n.	2	clea	clea	
28	31 0	31 0	12 4	13 0	1 5	1 3	N. w.	0	N. e.	2	clou	clea	
29	31 0	30 1	11 6	12 4	1 5	1 4	N. e.	1	E.	1	clea	clea	
30	30 0	30 0	12 6	14 2	1 8	1 5	S. w.	1	W.	1	clea	clea	
31	30 0		12 7		1 5		W.	2			clea		0 828

Total Depth 1, 625

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 9	13 3	1 6
Greatest Height	31 1	15 6	3 4
Least Height	29 3	11 5	1 1

SEPTEMBER, 1732.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind Forenoon. Direct.	Wind Forenoon. fo.	Wind Afternoon. Direct.	Wind Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	30 2	30 2	12 3	14 0	1 6	1 3	N. w.	1	N. w.	1	clea	clea	The Register of Rain was not kept this Month.
2	30 2	30 3	12 4	14 2	2 0	1 4	N. e.	1	N. e.	1	clea	clea	
3	30 3	30 3	12 5	12 7	2 5	2 5	E.	1	E.	1	mist	mist	
4	30 2	30 1	11 7	13 6	2 7	1 8	N.	0	N.	1	mist	mist	
5	30 1	30 0	12 2	13 3	2 9	2 6	N. e.	0	N. e.	1	mist	mist	
6	29 8	29 7	12 6	14 2	2 0	1 4	S. w.	2	W.	2	clea	clou	
7	29 8	29 9	12 8	13 6	1 9	1 6	E.	0	E.	0	clou	clou	
8	29 7	29 6	13 3	14 6	1 9	1 5	S. e.	1	S. w.	0	clou	clea	
9	29 5	29 5	13 9	12 7	1 7	1 8	S. w.	0	S. w.	1	clou	clou	
10	29 5	29 2	12 7	13 6	1 7	1 6	S. w.	1	S. w.	3	clou	low	
11	29 2	28 6	13 0	12 5	1 6	1 6	S. w.	3	S. w.	4	clea	stor	
12	28 8	29 0	12 1	12 1	1 6	1 4	W.	3	N. w.	2	clou	clea	
13	28 8	28 9	10 5	11 7	1 8	1 6	W.	2	W.	2	clea	clou	
14	29 1	29 2	10 8	12 1	1 5	1 1	N. *b* w.	2	N. w.	3	clea	clou	
15	28 9	28 8	11 8	11 5	1 3	1 5	S. w.	2	S. w.	2	rain	rain	
16	29 5	29 6	10 3	11 6	1 5	1 1	N.	1	W.	2	fair	fair	
17	29 0	29 0	11 8	10 7	1 7	1 5	N. w.	2	W.	3	fair	fair	
18	28 9	29 1	11 5	11 4	1 8	1 8	W.	3	W.	2	fair	fair	
19	29 3	29 4	10 8	10 8	2 0	1 7	W.	1	W.	1	fair	fair	
20	29 7		10 3		1 8		W.	1			fair		
21	29 5	29 6	12 8	13 0	1 6	1 3	W.	4	W.	4	stor	stor	
22	29 8	29 7	11 8	12 6	1 5	1 6	S. w.	2	S. w.	2	clou	clou	
23	29 7		11 5		2 0		W.	1			clou		
24	29 6	29 7	13 2	13 7	2 1	2 1	S. w.	0	S. w.	0	clou	rain	
25	29 8	30 0	12 3	13 1	2 1	1 5	W.	2	W.	0	fair	fair	
26	30 2	30 3	11 8	11 9	2 0	1 7	S. e.	0	E.	1	fair	fair	
27	30 2	30 0	11 8	12 4	1 7	1 5	E.	1	S. e.	2	clou	clou	
28	29 9	29 9	11 4	12 1	1 5	1 5	S. e.	1	S. e.	1	clou	clou	
29	30 1	30 1	10 5	11 9	1 7	1 5	S. e.	0	S. e.	1	fair	fair	
30	30 2	30 2	9 8	11 2	1 6	1 4	S. e.	0	S. e.	1	fair	fair	

Total Depth ———

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	12 2	1 7
Greatest Height	30 3	14 6	2 9
Least Height	28 3	9 8	1 1

OCTOBER, 1732.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D	I. D.	I. D.	I. D.							In. D.
1	30 1	30 0	10 8	11 1	1 4	1 3	S. e.	1	S. e.	1	fair	fog	
2	29 9	29 7	10 4	11 3	1 5	1 6	S. e.	1	E.	1	clou	clou	0 062
3	29 4	29 2	10 8	10 7	1 5	2 6	E.	1	N. e.	2	clou	rain	
4	29 1	29 2	10 4	10 9	3 0	2 4	N. e.	1	W.	1	fair	clou	
5	29 2	29 1	9 9	11 2	2 4	2 1	S. w.	1	E.	1	fair	rain	
6	29 3	29 3	9 8	11 0	2 3	1 5	N. w.	1	W. *b* n.	1	clea	clea	0 213
7	29 3	29 1	10 4	11 4	2 0	2 2	S. e.	1	S. e.	1	rain	rain	
8	29 1	29 2	11 1	11 9	2 5	2 0	S. w.	1	S. w.	1	fair	clou	
9	29 0	29 0	12 1	12 7	2 3	1 8	S.	1	S. *b* w.	1	fair	fair	
10	29 0	29 1	11 7	11 6	2 0	1 8	S. w.	2	W.	3	fair	fair	
11	29 2	29 0	10 5	11 9	1 9	2 2	S. e.	2	S. w.	1	fog	clou	
12	29 1	29 0	11 4	11 9	2 2	2 5	S. w.	0	S. *b* e.	1	fog	rain	
13	29 1	29 0	10 4	11 1	2 5	2 7	S. w.	0	W.	1	clou	rain	0 685
14	29 4	29 4	10 4	10 5	2 2	2 2	S. w.	1	S. *b* w.	1	fair	fair	
15	29 2	29 0	11 4	12 2	2 7	2 0	S. *b* w.	1	S. *b* w.	0	clou	clou	
16	29 4	29 2	10 6	11 3	2 5	2 2	S. w.	0	S. w.	1	fair	rain	0 426
17	29 0	28 9	11 6	11 8	2 3	2 0	S. w.	2	S. w.	2	clou	clou	
18	29 0	29 1	10 9	10 6	2 1	2 1	S. w.	2	S. w.	2	fair	clou	
19	29 4	29 5	10 8	11 4	2 1	2 3	S. w.	0	E.	1	fog	clou	0 395
20	29 5	29 5	10 8	10 7	3 0	3 0	N. w.	0	N. e.	0	clou	clou	
21	29 4	29 4	10 7	11 1	2 9	2 5	S. e.	1	S. e.	1	clou	fair	
22	29 5	29 5	11 3	11 6	2 3	2 2	S. w.	1	S. w.	1	clou	clou	
23	29 7	29 7	10 6	11 4	2 5	3 0	S. e.	1	E.	2	fair	clou	
24	29 6	29 6	11 2	11 5	3 7	3 9	N. e.	2	N. e.	2	rain	rain	
25	29 5	29 6	11 9	11 8	3 9	3 9	S. e.	1	S. e.	1	fog	fog	
26	29 5	29 5	12 3	12 3	2 6	2 9	S. e.	1	S. e.	1	fair	fair	0 530
27	29 7	29 6	11 5	11 6	3 6	3 4	S. e.	1	S. e.	1	fog	fog	
28	29 4	29 4	11 3	10 6	2 6	2 1	W.	2	W.	1	clou	fair	
29	29 6	29 7	9 5	10 4	2 4	2 2	W.	1	N. w.	2	fair	fair	
30	29 8	29 9	10 2	10 5	2 5	2 5	W.	1	W.	1	clou	clou	0 212
31	29 9	29 9	10 5	10 7	2 4	2 1	W.	0	S. w.	1	clou	clou	

Total Depth 2, 523

	Barom, In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 3	11 1	2 4
Greatest Height	30 1	12 7	3 9
Least Height	28 9	9 5	1 3

NOVEMBER, 1732.

Day.	Barom.		Thermom.		Hygroſc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 9	29 9	9 9	10 3	2 1	2 3	S.	0	S.	0	fair	fair	
2	29 9	30 0	10 0	9 5	2 3	2 1	S. e.	2	S. e.	1	clou	clou	
3	30 1	30 1	9 4	10 0	2 2	2 2	S. e.	1	S. e.	1	fog	fog	
4	30 1	30 1	9 5	9 7	2 2	2 2	S. e.	1	S. e.	1	clou	clou	
5	30 1	30 1	8 3	9 0	2 2	2 3	S. w.	0	S. w.	0	clou	fair	
6	30 2	30 2	8 2	9 6	2 4	2 1	S. w.	0	S. w.	0	fair	fair	
7	30 2	30 3	9 3	9 4	2 8	2 8	S. w.	2	S. w.	0	fair	fog	
8	30 3	30 3	8 7	9 2	3 1	3 3	W.	1	W.	1	fog	fog	
9	30 2	30 1	9 7	9 9	3 2	3 0	W.	1	W.	0	fog	fog	0 025
10	30 0	29 7	9 9	9 9	3 0	2 9	W.	0	W.	0	fog	fog	
11	29 6	29 5	9 1	9 5	2 8	2 8	S.	1	S. e.	1	clou	fair	
12	29 6	29 7	10 4	10 5	2 9	2 6	S. e.	1	S. e.	1	fog	fog	
13	29 7	29 7	10 9	10 2	2 9	2 7	S. e.	1	S. e.	2	rain	fog	0 075
14	29 8	29 9	9 5	9 7	3 5	3 4	S. e.	2	N. w.	2	clou	clou	0 257
15	29 8	29 8	8 7	8 4	2 3	2 0	N. *b* w.	3	N. *b* w.	2	clou	clou	0 033
16	29 7	29 8	9 1	8 7	2 0	1 8	N. e.	3	N.	3	fair	fair	
17	29 8	29 4	8 3	9 5	1 8	1 7	W.	2	W. *b* ſ.	2	fair	fair	
18	29 5	29 5	7 2	7 4	1 9	1 9	N. w.	1	N. w.	1	fair	fair	
19	29 4	29 5	6 7	7 7	2 0	1 8	N. w.	1	N. w.	3	fair	fair	
20	29 8	29 9	7 5	8 3	1 9	1 7	N. w.	1	N. w.	2	clou	clou	
21	30 0	30 0	7 4	9 0	2 0	2 0	N. w.	0	S.	1	fair	clou	0 012
22	30 1	30 2	10 5	10 6	2 9	3 2	S.	1	S.	0	clou	clou	
23	30 3	30 4	10 4	10 4	3 0	2 9	W.	1	W.	1	clou	clou	0 005
24	30 4	30 4	10 4	9 9	2 7	2 7	N. w.	1	W.	1	fair	fair	
25	30 4	30 4	9 9	9 6	2 9	2 9	W.	1	W.	1	fair	fair	
26	30 3	30 2	10 1	10 4	2 9	2 7	W.	1	W.	1	fair	fair	0 008
27	30 0	30 1	10 1	9 5	2 8	2 5	W.	1	N. *b* w.	1	fair	fair	
28	30 1	30 1	7 4	8 3	2 0	1 9	N. *b* w.	1	N. *b* w.	2	fair	fair	
29	29 8	29 8	9 9	10 5	2 5	2 5	W. *b* ſ.	3	W. *b* ſ.	3	clou	clou	
30	29 7	29 9	9 0	9 2	1 4	2 1	W.	2	W.	2	clou	clou	

Total Depth 0, 415

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	9 3	2 4
Greateſt Height	30 4	10 6	3 5
Leaſt Height	29 4	7 2	1 4

DECEMBER, 1732.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	30 1	30 1	8 2	8 8	2 3	2 4	W.	2	W.	2	fair	fair	
2	30 1	30 1	8 9	8 7	1 9	1 9	N. w.	2	N. w.	2	fair	fair	
3	30 1	29 9	9 0	9 7	2 0	2 2	S. w.	2	S. w.	2	clou	clou	
4	29 6	29 7	10 0	8 8	2 6	2 2	W.	2	N. w.	1	fair	fair	
5	29 8	29 9	9 0	9 1	2 2	2 1	N.	1	N.	1	fair	fair	
6	30 0	30 0	8 0	7 7	2 0	2 5	N.	1	N. *b* w.	0	fair	fair	
7	30 1	30 3	7 0	8 5	3 0	2 4	N.	1	N.	1	fair	fog	
8	30 4	30 4	9 1	9 1	2 3	2 3	E.	1	E.	1	fog	fair	
9	30 3	30 3	9 1	9 1	2 3	2 3	E. *b* ſ.	2	S. e.	2	fair	fog	0 032
10	30 2	30 1	8 7	9 2	2 0	2 1	S. e.	2	S. e.	2	fair	fair	
11	29 9	29 8	7 0	7 5	2 2	2 3	S. e.	1	S. e.	2	fog	fair	
12	29 8	29 8	7 5	8 0	2 5	2 5	S. e.	0	S. e.	1	fog	fog	
13	29 9	29 9	8 5	8 7	2 6	2 3	S. e.	1	S. e.	0	fog	fog	
14	29 8	29 7	6 7	6 6	2 5	2 4	S.	2	S.	1	fair	fair	
15	29 7	29 6	7 4	7 5	2 4	3 0	S.	1	S.	1	fog	fog	
16	29 6	29 6	8 1	8 4	3 0	2 5	S. e.	1	S. e.	1	fog	fair	
17	29 5	29 5	9 2	9 4	2 8	2 7	S.	1	S.	1	fair	fair	
18	29 4	29 4	8 8	8 1	3 1	3 1	W. *b* ſ.	1	W. *b* ſ.	1	fog	fog	
19	29 3	29 3	8 3	9 0	3 3	3 4	S. *b* e.	1	S. *b* e.	0	fog	fog	0 095
20	29 2	29 1	9 1	9 5	3 3	3 2	S.	0	S.	0	fog	fog	0 210
21	29 3	29 0	10 0	10 3	3 0	3 2	S.	0	W.	0	fog	fog	0 172
22	28 9	29 1	10 0	9 8	3 4	3 1	E.	2	E.	2	rain	rain	0 395
23	29 5	29 6	9 4	9 5	3 6	3 3	E.	2	E.	2	rain	rain	0 350
24	29 6	29 5	10 4	11 8	3 3	3 0	S.	3	S.	3	rain	clou	0 410
25	29 5	29 4	10 5	11 3	2 3	3 0	S. w.	0	S. w.	1	clou	clou	0 382
26	29 4	29 4	10 5	10 3	2 7	2 5	S. w.	1	S. w.	1	clou	clou	0 256
27	29 3	29 3	9 4	10 1	2 7	2 8	S. w.	2	S. w.	2	clou	clou	0 210
28	29 2	29 1	9 6	9 5	3 0	2 6	S. w.	2	W.	2	clou	clou	0 457
29	29 8	29 6	9 0	9 8	2 7	2 5	W.	2	S. w.	3	ſno	clou	0 365
30	28 2	28 2	10 6	10 5	2 5	2 5	S. w.	3	S. w.	3	rain	clou	0 198
31	28 8	29 0	10 0	9 5	2 4	2 0	N. w.	2	W.	2	fair	fair	0 085

Total Depth 3, 617

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 8	9 1	2 6
Greateſt Height ———	30 4	11 8	3 8
Leaſt Height ———	28 2	6 6	1 9

JANUARY, 1733.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 3	29 6	9 4	8 6	2 2	2 1	N. w.	2	W. *b*. n.	2	fair	fair	
2	29 5	29 3	9 6	10 6	2 3	2 5	S. w.	2	S. w.	2	rain	clou	0 054
3	29 4	29 3	9 7	9 8	2 3	2 3	S. w.	2	S. w.	3	fair	clou	0 135
4	29 1	29 0	10 6	11 7	2 2	2 3	S. w.	3	S. w.	4	rain	clou	0 217
5	29 2	29 3	10 6	10 7	2 0	2 0	S. w.	3	S. w.	2	fair	rain	
6	29 5	29 6	9 9	10 0	2 0	2 0	S. w.	2	S. w.	2	fair	fair	0 190
7	29 7	29 6	10 3	10 2	2 1	2 0	S.	2	S.	2	fair	fog	0 083
8	29 2	29 2	10 8	10 3	2 4	2 2	S. w.	1	W.	2	rain	fair	
9	29 2	29 2	9 2	10 2	2 4	2 2	W.	2	W.	2	fair	fair	0 225
10	29 4	29 5	9 3	9 5	2 3	2 1	W.	2	S. w.	3	fair	fair	
11	29 5	29 5	10 0	10 1	2 2	2 0	S. w.	2	S. w.	2	clou	clou	
12	29 5	29 6	8 7	9 6	2 1	2 0	E.	1	E.	1	fair	clou	0 053
13	29 6	29 6	9 1	9 4	2 1	2 0	S.	1	S. w.	1	fair	fair	
14	29 6	29 6	8 3	8 4	2 2	2 1	S. w.	1	S. w.	1	clou	fog	
15	29 6	29 6	9 4	9 2	2 3	2 1	S.	1	S. w.	2	fair	fair	
16	29 7	29 7	10 8	10 7	2 2	2 2	S.	2	S.	1	clou	clou	
17	29 8	29 9	10 7	10 4	2 2	2 6	S. w.	1	S. w.	1	rain	rain	
18	30 0	30 0	10 3	10 4	2 4	2 4	S. w.	1	S. w.	2	clou	clou	
19	30 1	30 1	9 3	7 7	2 3	2 0	S.	2	S. w.	1	fair	fair	0 093
20	30 1	30 1	7 7	8 2	1 6	1 5	W.	1	S.	1	fair	fair	
21	30 2	30 2	7 0	8 5	1 7	1 8	S.	1	S.	2	fair	fair	
22	30 2	30 2	7 8	8 2	2 1	1 9	S. e.	2	S. e.	2	fair	fair	
23	30 1	30 1	8 4	10 2	2 2	2 3	S. e.	2	S. w.	2	fair	clou	
24	30 0	30 1	11 1	11 6	2 3	2 2	S. w.	2	S. w.	2	clou	clou	0 055
25	30 0	29 9	11 1	12 1	2 2	2 2	S. w.	2	S. w.	3	fair	fair	
26	30 0	30 1	10 8	11 2	2 1	2 0	S. w.	3	S. w.	2	fair	fair	
27	30 1	30 1	10 4	10 4	2 2	2 4	S. w.	1	S. w.	2	*rai	fair	0 106
28	30 2	30 1	9 9	10 2	2 4	2 3	S. w.	1	S. w.	1	clou	clou	0 091
29	29 6	29 3	10 7	11 2	2 0	2 1	S. w.	2	S. w.	3	clou	clou	
30	29 1	29 3	10 5	10 1	2 1	1 9	S. w.	4	S. w.	3	fair	fair	0 068
31	29 0	29 1	9 1	9 7	1 9	1 9	S. w.	3	S. w.	2	fair		

Total Depth 1, 370

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	31 0	12 1	2 6
Least Height	29 0	7 0	1 5
Height at a Medium	29 8	9 6	2 1

* Rain when the Mercury is at 30. 1, is very extraordinary.

FEBRUARY, 1733.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind Forenoon		Wind Afternoon		Weath.		Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 2	29 1	10 6	11 4	2 2	2 2	S. w.	4	S. w.	4	rain	rain	0 135
2	28 9	29 0	10 1	9 2	2 2	2 3	S. w.	2	S. w.	2	clou	clou	0 193
3	29 2	29 1	9 7	9 8	2 1	2 1	S. w.	3	S. w.	2	fair	fair	0 233
4	28 9	20 8	9 5	10 0	2 1	1 7	S. w.	3	S. w.	3	fair	clou	0 089
5	29 0	29 4	9 6	10 6	2 0	1 8	W.	2	N. w.	2	fair	fair	0 063
6	29 8	29 8	9 2	10 3	2 3	2 2	W.	2	S. w.	2	fair	clou	
7	29 6	29 6	10 8	10 6	2 2	2 0	S. w.	2	W.	2	clou	rain	
8	29 4	29 3	9 5	8 8	2 2	3 0	E.	1	N. e.	3	rain	rain	
9	29 4	29 5	9 0	9 6	2 6	2 0	N.	2	N.	1	fair	fair	0 514
10	29 6	29 6	8 5	10 0	2 4	2 3	N.	1	W.	2	fair	fair	
11	29 3	29 3	11 3	11 0	2 5	2 3	S. w.	3	W.	3	clou	clou	
12	29 5	29 6	9 4	10 3	2 2	2 1	S. w.	3	W.	3	clou	clou	
13	29 4	29 4	11 2	11 7	2 2	2 0	S. w.	3	S. w.	3	fair	clou	
14	29 6	29 7	9 8	10 3	2 1	1 8	S. w.	2	W.	2	fair	fair	
15	29 8	29 8	9 7	2 2	10 7	2 0	S. w.	3	S. w.	3	fair	fair	0 137
16	29 8	29 7	10 7	2 2	11 5	1 9	S. w.	2	S. w.	3	fair	clou	
17	29 8	29 7	9 5	10 7	2 0	2 0	S. w.	3	S. w.	3	fair	fair	
18	29 7	29 6	11 0	10 8	2 0	1 8	S. w.	2	S. w.	2	clou	fair	
19	29 3	29 4	10 3	9 3	1 9	1 9	S. e.	2	S. w.	2	clou	clou	0 092
20	29 3	29 3	9 3	9 5	2 1	2 4	S. e.	2	S. e.	2	rain	rain	0 373
21	29 3	29 4	9 5	10 2	2 6	2 5	S. w.	1	S. w.	1	clou	clou	
22	29 4	29 4	9 5	10 1	2 3	2 0	S.	3	S. w.	4	fair	clou	0 315
23	29 2	29 4	9 6	10 2	1 4	2 1	S. e.	2	S. e.	2	clou	clou	0 142
24	29 6	29 7	10 0	10 7	2 2	1 8	S. w.	1	S. w.	1	clou	clou	
25	29 5	29 7	9 8	2 0	9 4	2 0	W.	2	W.	3	fair	fair	0 094
26	29 4	29 4	10 3	2 1	9 7	1 8	S. e.	4	S. w.	2	rain	clou	0 110
27	29 4	29 4	9 3	2 0	8 6	2 2	S. w.	3	S. w.	2	rain	ſno	
28	29 6	29 5	9 8	11 1	2 2	2 0	S. w.	2	S. w.	2	clou	clou	0 065

Total Depth 2, 525

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	9 9	2 1
Greateſt Height	29 8	11 7	3 0
Leaſt Height	28 8	8 5	1 4

MARCH, 1733.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	For^{n}.	Aft^{n}.	For^{n}.	Aft^{n}	For^{n}.	Aft^{n}.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo	Fo.	Af.	In. D.
1	29 7	29 5	11 8	11 9	2 4	2 0	S. w.	2	S. w.	4	clou	clou	0 035
2	29 6	29 9	10 5	10 2	2 1	1 7	S. w.	2	N.	3	clou	fair	0 073
3	30 2	30 2	9 4	10 8	2 2	1 5	W.	3	W.	2	fair	fair	0 042
4	30 2	30 1	10 6	11 0	2 4	2 1	W.	2	W.	2	fair	fair	
5	29 9	29 9	11 0	9 7	2 3	1 7	N. w.	3	N. w.	2	fair	fair	
6	29 9	29 8	9 8	10 0	2 1	1 9	N. w.	2	W.	2	fair	fair	0 100
7	29 3	29 2	9 4	10 0	2 2	1 6	S. w.	3	W.	2	rain	clou	0 072
8	29 2	29 4	8 9	9 1	2 0	1 7	N. w.	3	N. w.	2	fair	clou	0 254
9	29 5	29 6	8 2	8 1	1 5	1 5	N. w.	2	N. w.	2	fair	fair	0 050
10	29 7	29 7	8 4	8 0	1 6	2 4	N. w.	2	N.	1	clou	ſno	
11	29 7	29 6	7 6	9 0	2 3	2 0	N.	1	N. e.	1	fair	clou	0 151
12	29 7	29 8	8 8	9 7	2 6	2 5	S. e.	2	S. e.	2	rain	clou	
13	30 0	29 9	9 1	9 0	2 2	2 3	E.	2	E.	2	haz	haz	0 096
14	29 8	29 6	9 0	9 7	2 1	1 7	S. e.	1	S. e.	2	haz	fair	
15	29 5	29 4	8 9	8 7	1 8	1 8	S. e.	2	S.	2	haz	clou	0 194
16	29 1	29 1	8 5	9 4	2 5	2 6	S. e.	3	S. e.	3	ſno	rain	0 210
17	29 2	29 2	9 5	9 4	2 6	2 5	S. e.	1	S. e.	2	haz	rain	
18	29 3	29 4	9 1	8 9	2 5	2 6	S. e.	3	S. e.	2	fair	clou	0 292
19	29 4	29 4	9 2	8 9	2 2	2 0	N.	1	N. e.	3	fair	haz	
20	29 3	29 3	7 6	8 3	3 8	4 0	N. e.	4	E.	2	ſno	clou	
21	29 2	29 1	7 9	7 4	3 2	3 5	S. w.	2	S. w.	2	fair	fair	0 520
22	29 1	29 1	8 7	8 5	3 0	3 0	E.	2	N.	2	clou	haz	
23	29 4	29 4	8 7	9 5	3 2	2 9	N.	2	S. e.	2	clou	rain	0 118
24	29 3	29 2	9 6	12 1	3 1	2 6	S. e.	2	S. e.	2	rain	fair	0 070
25	29 3	29 4	11 3	12 5	2 8	1 8	S.	1	S.	1	fair	fair	0 130
26	29 4	29 3	10 3	10 3	3 9	3 4	E.	2	E.	2	miſt	miſt	0 054
27	29 4	29 4	11 3	12 4	3 5	2 3	S.	1	S.	1	fair	clou	
28	29 5	29 5	12 0	12 4	2 5	2 2	S. e.	1	S. e.	2	clou	clou	
29	29 6	29 7	11 0	11 4	3 0	3 2	E.	2	E.	2	haz	rain	
30	29 9	29 9	10 5	10 2	2 8	2 9	E. *b* n.	2	E. *b* n.	2	clou	fair	
31	29 9		11 5		2 6		E. *b* n.		E. *b* n.	0	fair		0 177

Total Depth 2, 638

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 6	9 9	2 4
Greateſt Height ———	30 2	12 5	3 9
Leaſt Height ———	29 1	7 4	1 5

APRIL, 1733.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo	Weath. Af	Rain. In. D.
1	29 9	29 9	11 2	12 6	2 9	2 6	N. e.	1	N. e.	0	mist	mist	
2	29 9	29 9	12 5	12 7	2 4	1 7	N.	1	N.	0	clou	fair	
3	30 0	30 0	12 0	13 0	1 8	1 7	N. w.	2	N. w.	1	fair	clou	
4	30 1	30 1	10 8	10 3	2 8	2 9	N.	0	N.	2	mist	mist	
5	30 1	30 1	12 7	12 7	1 8	1 8	N. e.	1	N.	1	mist	fair	
6	30 1	29 9	11 9	13 1	1 7	1 5	S. w.	1	N.	1	fair	fair	
7	29 9	29 8	11 6	11 8	1 8	1 5	S. w.	0	S. w.	1	fair	fair	
8	29 6	29 5	12 5	11 9	1 6	1 8	S.	2	S. w.	1	clou	driz	
9	29 6	29 6	11 9	11 8	1 8	1 4	W. *b* f.	2	W.	2	fair	fair	
10	29 6	29 6	11 6	12 0	1 5	1 5	S. w.	3	S. w.	1	fair	clou	
11	29 6	29 5	11 6	11 5	1 6	1 6	S. w.	2	S.	2	fair	clou	0 023
12	29 5	29 5	12 2	11 7	1 7	1 7	S.	2	S.	2	clou	clou	
13	29 4	29 4	12 6	11 7	1 7	2 1	S. e.	1	E.	1	fair	fog	
14	29 4	29 6	11 8	11 0	2 3	1 9	S. e.	2	S. e.	2	clou	clou	0 055
15	29 8	29 9	11 3	10 7	2 0	2 5	E.	1	E.	2	fair	clou	
16	30 0	30 0	10 8	10 6	3 0	2 4	N. e.	2	N. e.	2	fair	fair	
17	29 8	29 7	10 7	11 0	2 9	2 7	N. e.	3	N. e.	2	fog	fog	0 073
18	29 5	29 2	10 7	10 5	3 0	3 7	N. e.	2	N. e.	3	fog	rain	
19	29 3	29 5	11 2	12 6	3 4	2 1	S.	2	S.	1	clou	fair	0 187
20	29 7	29 8	12 2	12 4	2 3	2 1	S.	1	W.	1	clou	rain	
21	29 9	29 8	12 1	11 9	2 1	2 0	S. w.	1	E.	1	fair	fair	
22	29 8	29 8	11 4	11 9	2 0	2 1	E.	2	E.	2	fair	clou	
23	29 8	29 7	10 7	10 6	2 3	3 5	N. e.	2	N. e.	3	clou	clou	
24	29 7	29 8	10 4	10 8	2 6	2 0	N. e.	3	N. e.	2	clou	fair	0 262
25	29 9	29 9	10 5	11 5	2 0	1 7	N. e.	2	N. e.	2	fair	clou	
26	29 9	29 9	10 4	11 1	1 8	1 6	N. e.	2	N. e.	2	fair	fair	0 095
27	30 0	29 9	10 9	12 6	1 8	1 4	N.	2	N.	1	fair	clou	
28	30 0	30 1	10 9	11 4	2 0	2 0	N. e.	2	N. e.	1	clou	clou	
29	30 1	30 1	12 4	13 4	1 9	1 4	N. w.	2	N. w.	2	fair	fair	
30	30 2	30 2	11 7	11 8	1 6	1 5	E.	1	E.	1	clou	clou	0 123

Total Depth 0, 818

	Barom. In. D.	Ther In. D.	Hygr. In. D.
Height at a Medium	29 7	11 6	2 0
Greatest Height	30 2	13 4	3 7
Least Height	29 2	10 3	1 4

MAY, 1733.

Day.	Barom. For$^{n.}$	Barom. Aft$^{n.}$	Thermom. For$^{n.}$	Thermom. Aft$^{n.}$	Hygrosc. For$^{n.}$	Hygrosc. Aft$^{n.}$	Wind: Forenoon. Direct.	Wind: Forenoon. fo.	Wind: Afternoon. Direct.	Wind: Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	30 1	30 0	12 2	13 7	1 6	1 4	W.	1	W.	2	clou	fair	
2	29 9	29 8	12 6	12 8	1 6	1 5	W.	1	E.	2	fair	clou	
3	29 8	29 8	12 1	10 7	2 1	2 3	E.	2	E.	2	fair	clou	
4	29 9	29 9	11 4	11 1	1 5	1 5	E.	1	E.	1	fair	fair	
5	30 0	29 9	11 2	12 4	1 5	1 4	E.	1	E.	1	fair	fair	
6	29 9	29 8	11 2	13 0	1 6	1 4	E. *b* n.	2	E. *b* n.	2	fair	fair	
7	29 6	29 6	11 6	13 4	1 5	1 2	S. e.	1	S. e.	2	fair	fair	
8	29 6	29 6	10 7	12 3	1 4	1 3	N. e.	1	N. e.	2	clou	clou	
9	29 6		11 7		1 4		N. e.	2			fair		
10													
11	29 7	29 7	12 9	13 4	1 3	1 4	E.	1	E.	1	fair	fair	
12	29 7	29 7	12 3	13 8	1 3	1 2	E.	1	E.	1	fair	fair	
13	29 8	29 9	12 8	13 1	1 4	1 3	E.	1	N. e.	1	fair	fair	
14	29 9	29 9	12 7	13 3	1 7	1 6	N. e.	1	E.	2	fair	fair	
15	30 0	30 0	12 5	12 0	1 6	1 3	E.	2	E.	1	fair	fair	
16	30 0	30 0	13 2	12 2	1 4	1 5	S. e.	1	E.	1	fair	fair	
17	30 0	29 9	12 3	12 7	1 7	1 8	E.	1	E.	1	fair	fair	
18	29 9	29 9	12 4	12 9	2 2	1 8	E.	1	E.	1	rain	clou	
19	29 9	29 8	12 6	13 5	1 8	1 3	E.	1	S. w.	0	clou	clou	0 032
20	29 8	29 8	13 3	12 8	1 6	1 4	W.	2	W.	2	clou	clou	
21	29 9	29 9	13 2	13 2	1 5	1 3	W.	2	W.	2	fr	clou	
22	29 9	29 9	13 2	14 0	1 9	1 1	W.	1	W.	2	clou	fair	
23	30 1	30 1	14 0	13 7	1 5	1 4	N. w.	2	N.	2	fair	fair	
24	30 1	30 1	12 5	12 0	1 6	1 7	E.	2	E.	2	fair	clou	
25	30 0	29 9	12 3	11 6	1 4	1 6	E. *b* n.	2	E. *b* n.	2	clou	clou	0 045
26	29 9	30 1	12 0	12 2	2 5	2 5	N. e.	2	N. e.	2	clou	clou	
27	30 1	30 2	12 0	12 7	3 1	2 5	N. e.	2	N. e.	2	clou	fair	
28	30 1	30 0	13 8	15 9	2 0	1 1	N. e.	0	N. e.	0	fair	fair	
29	29 9	29 8	15 3	13 4	1 3	1 6	N.	1	E.	1	fair	clou	
30	29 8	29 9	12 9	12 8	1 3	1 3	E.	1	E.	1	fair	fair	0 006
31	29 7	29 8	14 1	12 2	1 3	1 1	N. w.	2	N.	2	fair	fair	

Total Depth 0, 083

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	12 7	1 5
Greatest Height	30 2	15 9	3 1
Least Height	29 9	10 7	1 1

JUNE, 1733.

Day.	Barom. For^{n}.	Barom. Aft^{n}.	Thermom For^{n}.	Thermom Aft^{n}.	Hygrosc. For^{n}	Hygrosc. Aft^{n}.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D	I. D	I. D.	I. D.	I. D.							In. D.
1	29 9	29 8	12 7	13 3	0 9	0 9	N.	2	W.	3	fair	fair	
2	29 8	29 9	13 7	14 3	1 1	1 5	W. *b* n.	2	W. *b* n.	1	fair	fair	
3	30 0	30 0	12 6	13 4	1 3	1 1	E.	1	E.	1	clou	clou	
4	30 0	29 9	13 6	13 0	1 1	1 5	S. e.	1	E.	0	clou	clou	
5	29 8	29 8	13 3	12 6	1 8	1 5	E.	2	E.	2	clou	clou	
6	29 8	29 8	13 4	12 8	1 5	1 5	E.	1	E.	2	fair	fair	
7	29 8	29 8	13 4	15 0	1 5	1 2	E.	1	E.	1	fair	clou	
8	29 7	29 8	12 9	13 0	1 5	1 3	E.	2	E.	2	clou	fair	
9	29 7	29 6	13 3	13 2	1 2	1 4	E.	1	S. e.	1	fair	clou	
10	29 8	29 9	12 7	12 7	1 2	1 2	N. e.	1	E.	2	fair	clou	
11	29 9	29 9	13 8	13 7	1 4	1 3	E.	1	E.	0	fair	clou	
12	29 9	29 7	14 8	13 5	1 5	1 8	S. e.	0	E.	2	clou	rain	0 034
13	29 7	29 7	13 4	14 5	2 8	2 1	N.	0	N.	1	rain	clou	
14	29 7	29 7	14 4	15 3	2 0	1 4	N.	1	W.	1	fair	fair	0 386
15	29 8	29 8	15 6	15 5	1 4	1 1	S. w.	1	S. w.	1	clou	clou	0 350
16	29 7	29 6	16 0	14 3	1 5	1 4	S.	0	S. w.	2	clou	fair	0 190
17	29 6	29 5	15 6	14 3	1 2	1 4	S.	2	S. w.	2	clou	clou	0 085
18	29 5	29 3	14 6	13 5	1 6	1 4	W.	2	W.	2	clou	clou	0 055
19	29 2	29 1	14 1	13 5	1 4	1 5	W.	2	S. w.	1	fair	rain	0 035
20	28 9	28 9	14 1	14 5	1 8	1 5	S. e.	1	W.	2	rain	fair	0 316
21	29 3	29 6	13 9	13 7	1 7	1 3	W.	3	W.	3	rain	fair	0 173
22	29 8	29 9	14 2	14 6	1 4	1 3	S. w.	1	S. w.	1	rain	clou	0 145
23	29 9	29 9	15 0	15 2	1 5	1 2	W.	2	W.	0	clou	fair	
24	29 9	29 9	14 8	15 4	1 3	1 5	E.	1	E.	0	fair	fair	
25	29 8	29 9	16 0	16 0	1 4	1 3	S. w.	0	W.	0	clou	fair	0 084
26	29 9	29 9	15 3	16 1	1 7	1 7	E.	0	E.	0	fog	fair	0 100
27	29 9	29 8	15 2	14 1	1 8	2 5	E.	1	E.	2	fog	rain	
28	29 8	29 8	16 0	15 0	1 6	1 2	S. w.	2	S. w.	1	clou	clou	0 150
29	29 8	29 8	14 8	14 1	1 4	1 7	S. w.	2	S. w.	2	fair	clou	
30	29 9	29 9	14 7	14 7	1 6	1 6	S. w.	2	S. w.	2	fair	fair	0 035

Total Depth 2, 138

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	14 2	1 3
Greateſt Height	30 0	16 1	2 8
Leaſt Height	28 9	12 6	0 9

JULY, 1733.

Day	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 9	29 9	15 5	15 0	1 4	1 1	N. w.	1	W.	1	fair	fair	
2	29 9	29 9	15 3	15 8	1 5	1 3	E.	1	E.	1	fair	fair	
3	29 9	30 0	14 5	15 0	1 4	1 5	E.	1	E.	1	fair	fair	
4	30 1	30 0	14 7	15 1	1 9	1 7	S. e.	1	W.	2	fair	fair	
5	29 9	29 9	15 7	15 6	1 7	1 6	E.	1	E.	1	fair	clou	0 045
6	30 0	30 0	15 0	15 7	1 5	1 5	S. e.	2	S. w.	2	fair	fair	
7	30 1	30 0	14 5	15 6	1 5	1 6	W.	2	W.	0	clou	fair	
8	29 9	29 9	15 1	14 2	1 4	1 4	W.	3	W.	2	fair	clou	
9	29 7	29 7	14 3	14 3	1 6	1 6	W.	3	W.	3	clou	clou	
10	29 7	29 8	13 8	13 5	1 3	1 2	N. w.	3	N. w.	3	fair	clou	0 145
11	29 8	29 8	14 2	14 9	1 5	1 5	W.	3	W.	3	fair	clou	
12	29 8	29 7	13 9	15 0	1 6	1 6	W.	2	W.	1	clou	clou	
13	29 6	29 5	14 5	15 3	1 7	1 4	W.	2	W.	3	fair	fair	
14	29 6	29 6	12 2	13 2	2 1	1 4	N. e.	2	N. e.	1	clou	fair	0 093
15	29 6	29 6	14 6	13 7	1 4	1 3	N. e.	1	N. e.	1	fair	fair	
16	29 6	29 6	13 1	12 7	2 2	2 8	E.	2	N. e.	2	rain	clou	
17	29 6	29 6	13 4	14 0	3 5	2 0	N. e.	2	N. e.	1	clou	clou	
18	29 7	29 7	14 1	14 0	2 0	1 6	N.	1	N. e.	0	fair	fair	0 054
19	29 7	29 7	13 6	14 1	1 6	1 7	N. w.	2	N. w.	2	fair	fair	
20	29 8	29 8	14 0	15 4	1 6	1 4	W.	2	W.	2	fair	fair	
21	29 7	29 7	14 0	15 6	2 0	1 2	W.	2	N. w.	1	fair	fair	
22	29 8	29 8	15 5	15 5	1 5	1 3	W.	2	W.	2	fair	fair	
23	29 8	29 8	14 8	15 9	1 6	1 6	W.	2	W.	3	clou	clou	
24	29 8	29 8	15 1	15 3	2 0	1 4	W.	2	W.	2	fair	fair	
25	29 9	29 9	14 0	14 8	1 7	1 3	W.	2	W.	3	fair	fair	0 115
26	29 8	29 8	14 4	14 0	1 5	1 5	W.	3	W.	2	fair	fair	
27	29 8	29 8	13 3	14 8	1 6	1 0	W.	2	W.	2	fair	fair	
28	29 7	29 6	14 7	15 3	1 4	1 3	S.	1	S. *b* w.	0	fog	clou	
29	29 5	29 4	14 3	14 3	1 5	1 9	E.	1	W.	1	fair	clou	0 186
30	29 4	29 4	13 8	14 5	2 0	1 1	N. *b* w.	1	N. w.	2	fair	fair	
31	29 4	29 4	13 0	13 2	1 7	1 4	W.	2	N. w.	2	fair	fair	

Total Depth 0, 638

	Barom.	Ther.	Hygr.
	In. D.	In. D.	In. D.
Height at a Medium	29 7	14 6	1 6
Greatest Height	30 1	15 8	3 5
Least Height	29 4	12 2	1 0

AUGUST, 1733.

Day.	Barom. For^n^.	Barom. Aft^n^.	Thermom. For^n^.	Thermom. Aft^n^.	Hygrosc. For^n^.	Hygrosc. Aft^n^.	Wind Forenoon. Direct.	Wind Forenoon. fo.	Wind Afternoon. Direct.	Wind Afternoon. fo.	Weath Fo.	Weath Af.	Rain
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 5	29 6	13 5	13 9	1 3	1 3	W.	2	N. w.	1	clou	fair	
2	29 6	29 6	12 7	13 8	1 5	1 0	W.	1	E.	1	fair	fair	
3	29 6	29 5	13 6	13 5	1 3	1 4	E.	1	E.	1	fair	fair	
4	29 4	29 5	13 3	13 6	1 5	1 5	S. e.	2	E.	1	clou	clou	
5	29 5	29 5	13 8	13 5	1 8	1 8	E.	1	E.	1	clou	rain	
6	29 4	29 4	14 4	13 3	2 4	3 1	E.	1	E.	1	rain	og	0 056
7	29 4	29 4	13 7	13 6	3 1	3 2	E.	2	N. e.	1	clou	fog	0 093
8	29 4	29 5	13 6	13 6	3 3	2 2	N. e.	1	W.	1	clou	clou	
9	29 7	29 7	13 1	14 8	1 9	1 5	N. w.	0	N. w.	0	clou	fair	
10	29 7	29 7	13 6	13 4	1 8	1 9	S. w.	0	S. e.	1	clou	clou	0 075
11	29 7	29 8	12 4	14 5	2 0	1 3	W.	1	W.	1	fair	fair	
12	29 7	29 7	15 0	13 5	1 4	1 3	S. w.	4	S. w.	4	clou	clou	0 035
13	29 7	29 8	13 1	14 3	1 4	1 2	W.	2	W.	1	fair	fair	
14	29 4	29 4	14 1	13 8	1 3	1 4	S. w.	3	W.	3	fair	fair	0 188
15	29 7	29 7	12 4	14 0	1 7	1 4	W.	1	W.	1	fair	clou	0 210
16	29 6	29 7	12 0	13 0	1 8	1 7	N. w.	1	N. w.	0	rain	clou	0 490
17	29 7	29 4	12 4	13 2	1 6	1 6	S. w.	2	S. w.	4	fair	clou	0 365
18	29 3	29 2	13 6	13 4	2 0	1 8	S. w.	3	S. w.	3	clou	clou	
19	29 7	29 8	12 5	13 0	1 5	1 3	N. w.	2	N. w.	0	clou	clou	0 154
20	29 7	29 6	13 8	15 0	1 7	1 9	S. w.	0	S. w.	1	rain	clou	
21	29 6	29 6	14 1	12 9	2 3	1 9	S. w.	2	W.	1	clou	clou	
22	29 7	29 7	12 6	12 9	1 9	1 5	W.	1	W.	1	fair	fair	
23	29 8	29 8	12 7	13 [illegible]	1 8	1 4	W.	1	W.	1	fair	fair	0 193
24	29 7	29 5	13 2	13 9	1 4	1 5	S. w.	2	S. w.	3	clou	fair	0 055
25	29 5	29 6	12 3	12 3	1 5	1 5	W.	2	W.	2	fair	fair	
26	29 6	29 7	12 9	13 2	1 6	1 2	N. w.	2	N. w.	1	fair	fair	
27	29 6	29 6	12 8	12 8	1 9	1 6	S. w.	1	W.	1	clou	fair	0 100
28	29 5	29 4	11 5	12 7	1 6	1 6	W.	1	S.	0	fair	clou	
29	29 1	29 1	12 1	12 6	1 9	1 5	S. w.	1	W.	1	rain	fair	0 286
30	29 4	29 5	12 5	13 0	1 4	1 3	N. w.	2	N. w.	1	fair	fair	0 375
31	29 3	29 2	12 1	12 4	1 9	1 4	S.	1	W.	2	rain	fair	

Total Depth 2, 675

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	13 2	1 7
Greatest Height	29 8	15 0	3 3
Least Height	29 1	12 1	1 0

SEPTEMBER, 1733.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^n.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 2	29 0	12 6	11 5	1 7	1 5	S. w.	2	W.	2	fair	clou	0 084
2	28 9	29 0	12 7	12 6	1 5	1 6	S. w.	1	E.	1	clou	fair	0 055
3	29 2	29 4	12 0	12 8	1 7	1 2	N. w.	2	N. w.	2	clou	fair	
4	29 5	29 2	12 0	11 5	1 7	1 5	S. w.	3	S. w.	2	fair	rain	0 230
5	29 0	29 3	12 2	12 4	1 8	1 5	S. w.	3	W.	3	fair	fair	0 067
6	29 6	29 7	11 3	12 3	2 0	1 4	W.	2	S. w.	2	fair	fair	
7	29 6	29 7	11 4	12 1	1 6	1 5	W.	2	W.	2	fair	fair	
8	29 8	29 9	11 0	11 0	1 9	1 5	W.	2	N.	2	fair	clou	0 108
9	30 0	30 1	10 5	12 1	1 6	1 3	N.	2	N. *b* w.	1	fair	fair	
10	30 1	30 1	11 3	12 3	1 5	1 3	S. w.	1	S. *b* e.	1	fair	fair	
11	30 1	30 0	11 3	13 5	1 5	1 2	S. *b* e.	2	S. *b* e.	2	fair	fair	
12	29 8	29 7	11 9	13 4	1 7	1 6	S. e.	2	S. e.	2	fair	rain	0 177
13	29 8	29 8	13 3	14 3	1 9	1 8	S.	1	S.	1	rain	clou	0 030
14	29 9	29 9	13 0	13 4	3 0	2 8	S. e.	1	S. e.	1	mist	mist	0 026
15	30 0	30 0	12 5	12 3	3 3	3 2	S e.	1	E.	2	mist	mist	
16	30 0	30 0	12 2	11 3	2 7	2 1	E.	2	E.	1	fog	fair	
17	30 1	30 1	12 0	13 0	2 1	1 9	E.	1	E.	1	fog	clou	
18	30 2	30 2	12 3	13 0	2 1	2 1	S. w.	1	S. w.	1	clou	clou	
19	30 2	30 1	13 2	13 8	2 4	1 7	S. w.	2	W.	2	fair	fair	
20	29 9	29 9	13 6	13 8	1 9	2 0	S. w.	2	S. w.	2	clou	rain	
21	29 8	29 9	11 9	11 7	2 2	2 0	W. *b* ſ.	2	S.	2	fair	fair	0 356
22	29 9	29 9	12 2	12 8	2 5	1 9	W.	2	W.	1	fair	fair	
23	29 8	29 7	12 5	13 1	2 0	1 6	S. w.	1	S. w.	1	fair	fair	0 240
24	29 4	29 3	12 5	13 2	2 2	1 7	S. w.	2	S.	2	fair	low	
25	29 1	28 9	11 0	11 8	1 9	1 8	S. w.	2	S. *b* w.	2	fair	rain	
26	28 4	28 6	10 8	10 5	2 0	1 7	S. w.	4	S. w.	3	clou	clou	0 395
27	28 9	29 2	11 1	11 8	1 8	1 5	W.	3	W.	3	fair	fair	0 094
28	29 1	29 1	12 3	12 3	2 1	1 7	S. w.	2	S. w.	4	clou	clou	
29	29 4	29 5	11 7	11 6	1 8	1 7	W.	4	W.	3	clou	fair	
30	29 7	29 7	11 4	11 7	1 9	1 7	W.	2	W.	1	fair	clou	0 073

Total Depth 1, 835

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	12 2	1 9
Greateſt Height	30 2	13 8	3 3
Leaſt Height	28 4	10 5	1 2

OCTOBER, 1733.

Day	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 8	29 5	11 2	12 4	2 5	1 9	S. w.	1	S. w.	1	rain	clou	0 045
2	29 5	29 4	13 3	13 7	2 1	1 8	S. w.	1	S. w.	3	clou	clou	
3	29 1	29 1	12 9	12 5	1 7	1 7	S. w.	4	S. w.	4	clou	fair	0 060
4	29 5	29 7	11 6	11 8	2 0	1 5	W.	2	N. w.	2	fair	fair	
5	30 1	30 2	10 6	11 8	1 3	1 4	W. *b* n.	1	W. *b* n.	1	fair	fair	
6	30 3	30 4	9 9	10 4	1 7	1 7	N. w.	1	N. w.	0	fair	fair	
7	30 4	30 2	10 5	11 3	1 8	1 7	S. w.	1	S. w.	1	clou	clou	
8	30 0	30 0	11 4	11 7	1 7	1 7	S. w.	1	W. *b* ſ.	2	fair	clou	
9	30 0	30 0	11 4	10 9	2 6	2 7	N. e.	2	E.	2	rain	fog	
10	29 9	29 8	11 1	11 4	2 4	2 2	S. e.	1	S. e.	2	clou	clou	0 124
11	29 7	29 6	11 3	11 3	2 3	2 0	S. e.	1	E.	2	clou	clou	
12	29 5	29 4	11 2	11 3	2 4	2 3	S. e.	1	E.	1	low	clou	
13	29 4	29 5	9 1	10 7	2 2	2 1	N. w.	2	N. w.	3	fair	clou	
14	29 7	29 8	10 2	10 4	1 9	1 5	N. w.	2	N. w.	2	fair	fair	
15	30 0	30 0	9 4	10 2	1 7	1 7	N. w.	2	N. w.	2	fair	fair	
16	30 1	30 2	10 1	10 8	2 0	1 7	N. w.	1	N. w.	1	fair	fair	
17	30 3	30 3	8 9	9 4	1 9	1 7	W. *b* n.	1	W. *b* n.	1	fair	fair	
18	30 4	30 4	9 9	11 0	1 9	1 8	S. w.	1	S.	1	fair	fair	
19	30 4	30 4	10 8	11 5	1 9	1 8	S. w.	1	W.	0	fair	fair	
20	30 3	30 3	10 0	11 0	1 8	1 7	W.	2	W.	2	fair	fair	0 030
21	30 3	30 2	10 6	11 1	1 7	1 7	W.	0	W.	2	clou	clou	
22	30 1	30 1	10 7	10 8	2 0	2 0	S. w.	2	W.	2	fair	fair	
23	30 0	29 9	10 6	11 0	2 0	2 0	W.	0	W.	0	clou	clou	
24	29 7	29 5	10 1	10 8	2 0	1 7	S. w.	0	S. w.	2	fair	clou	
25	29 0	28 9	11 5	11 9	2 2	1 7	S. w.	2	S. w.	2	clou	clou	
26	29 0	29 1	10 8	11 2	1 9	2 0	S. w.	3	S. w.	3	fair	clou	
27	29 1	29 2	10 1	9 8	1 9	1 8	S. w.	3	S. w.	3	clou	rain	0 206
28	29 4	29 3	10 3	11 9	2 0	2 4	S. w.	2	S. w.	3	clou	rain	0 154
29	29 1	29 1	11 7	10 6	2 4	1 9	S. w.	4	W.	4	clou	clou	0 380
30	29 7	30 0	9 0	9 2	1 6	1 4	W.	2	N. w.	2	clou	clou	0 084
31	30 2	29 9	9 3	11 3	1 5	1 9	S. w.	2	S. w.	3	clou	clou	

Total Depth 1, 083

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	10 9	1 9
Greateſt Height	30 4	13 7	2 7
Leaſt Height	28 9	8 9	1 3

NOVEMBER, 1733.

Day.	Barom.		Thermom		Hygrosc.		Wind.				Weath.		Rain.
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^r.	Forenoon.		Afternoon.				
	I. D.	I. D	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo	Fo.	Af.	In. D.
1	29 7	29 7	12 2	12 4	2 3	2 3	S. w.	3	S. w.	2	clou	clou	
2	29 7	29 7	12 4	11 8	2 2	1 8	W.	3	W.	3	fair	clou	0 053
3	29 8	29 9	10 6	10 2	1 8	1 7	W.	2	W.	2	clou	fair	
4	30 3	30 3	9 4	10 0	1 8	1 7	N.	1	N.	1	fair	clou	
5	30 1	30 1	11 6	12 0	2 5	2 3	N.	3	W.	2	clou	clou	
6	30 2	30 3	11 8	11 9	2 3	2 2	W.	0	W.	1	clou	clou	
7	30 3	30 2	11 5	11 8	2 0	1 7	W.	1	W.	1	clou	clou	0 085
8	30 0	29 9	11 4	11 5	2 0	2 0	S.	0	S.	3	clou	clou	
9	29 8	29 7	10 8	10 3	2 2	1 9	S. w.	2	S. w.	2	fair	fair	
10	29 2	29 1	10 7	9 9	1 8	1 9	S. w.	3	S. w.	4	fair	clou	
11	29 2	29 2	9 1	9 7	2 0	2 0	W.	2	W.	2	fair	clou	
12	29 2	29 5	8 2	9 4	2 0	1 9	N. w.	2	N. w.	2	fair	fair	
13	29 7	29 6	9 3	10 8	2 0	2 0	S. w.	2	S. w.	2	clou	clou	0 066
14	29 4	29 6	12 0	11 5	2 0	2 0	S. w.	3	S. w.	2	clou	clou	
15	29 6	29 5	12 4	12 7	2 3	2 0	S. w.	2	S. w.	4	clou	clou	
16	29 8	29 8	9 8	9 8	2 0	1 9	S. w.	2	S. w.	2	fair	fair	
17	29 5	29 6	10 6	9 9	2 0	1 9	S.	4	W.	2	clou	clou	
18	29 8	29 8	9 7	10 4	2 0	1 9	S. w.	2	S. w.	2	fair	fair	
19	29 7	29 8	9 6	10 4	2 0	2 0	S. w.	2	S. w.	2	fair	fair	
20	29 7	29 6	11 0	10 6	2 1	1 9	S.	2	S.	2	clou	clou	
21	29 5	29 6	10 9	11 3	2 0	2 0	S. e.	2	S. e.	2	fair	fair	
22	29 8	29 8	11 7	11 9	2 1	2 0	S.	1	S.	1	fair	fair	
23	29 8	29 7	11 5	11 5	2 1	2 0	S. w.	3	S. w.	2	fair	clou	
24	29 7	29 6	11 9	12 4	2 7	2 4	S. w.	2	S. w.	2	clou	clou	
25	29 7	29 7	10 2	10 3	1 9	1 9	W.	3	W.	3	fair	fair	0 037
26	29 7	29 5	10 2	10 4	2 0	2 5	W.	3	W.	4	fair	rain	
27	29 8	29 9	9 5	10 2	1 8	1 8	W.	2	W.	2	fair	clou	
28	29 8	29 7	11 0	11 1	2 4	1 9	W.	2	W.	3	fair	clou	
29	29 8	29 7	11 0	11 8	2 0	2 2	W.	2	W.	3	clou	rain	
30	29 5	29 6	11 5	9 7	2 0	1 9	S. w.	2	S. w.	3	fair	clou	0 095

Total Depth 0, 326

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	10 8	2 0
Greatest Height	30 3	12 7	2 7
Least Height	29 1	8 2	1 7

DECEMBER, 1733.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrofc. For^n.	Hygrofc. Aft^n.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D							In. D.
1	29 6	29 6	9 3	9 2	2 0	2 0	W.	2	W.	2	fair	fair	0 205
2	29 4	29 3	12 0	11 1	2 6	2 1	W.	4	W.	4	clou	fair	0 146
3	29 7	29 9	9 6	10 1	1 7	1 9	W.	2	W.	2	fair	fair	0 072
4	30 0	30 1	11 2	11 4	2 2	2 3	W.	2	W.	2	clou	fair	
5	30 2	30 2	11 1	11 4	2 1	2 1	W.	1	S. w.	2	clou	clou	
6	30 2	30 1	10 7	11 1	2 0	1 9	S. w.	2	S. w.	1	clou	clou	
7	30 0	30 0	10 0	10 2	2 0	1 9	S. w.	1	S. w.	1	clou	clou	
8	30 0	29 9	9 7	10 7	2 0	2 0	S. w.	1	S. w.	1	fair	fair	
9	29 7	29 6	9 0	9 5	1 9	1 9	S. w.	1	S. w.	1	fog	clou	
10	29 1	29 3	10 5	10 2	2 2	2 1	S.	2	S. w.	2	clou	clou	
11	29 0	29 0	11 5	12 0	2 4	2 2	S.	1	S.	1	fair	fair	0 248
12	29 1	29 0	10 7	11 8	1 9	2 1	S. w.	4	S. w.	4	rain	rain	0 153
13	29 1	29 0	10 7	10 8	2 2	2 1	S.	0	S. w.	2	fog	clou	0 124
14	29 0	28 8	10 9	11 4	2 0	2 2	S.	2	S.	2	fog	clou	0 176
15	29 2	29 3	11 1	10 9	2 1	1 9	S. w.	3	S. w.	4	clou	clou	0 198
16	29 2	29 3	10 3	9 9	2 2	2 3	S.	2	N. w.	1	rain	fair	0 344
17	29 4	29 4	10 0	10 3	2 4	2 5	W.	2	W.	1	rain	fair	0 565
18	29 4	29 4	12 6	12 5	2 3	2 5	S. w.	4	S. w.	3	fair	fair	0 223
19	29 6	29 7	11 5	11 7	2 2	2 2	S. w.	2	W.	1	fair	fair	
20	29 7	29 7	11 7	11 7	2 2	2 2	S. e.	1	S. w.	1	clou	clou	0 274
21	29 6	29 6	11 9	11 3	2 3	2 1	S.	0	W.	1	fog	fair	0 074
22	29 5	29 1	10 3	10 7	2 1	2 2	S. w.	1	S. w.	3	fair	clou	0 155
23	29 2	29 3	10 2	10 6	1 9	1 8	S. w.	2	S. w.	2	fair	fair	0 130
24	29 3	29 5	9 7	9 7	2 8	2 0	S. w.	2	W.	2	fair	fair	0 195
25	29 4	29 4	9 9	9 5	2 1	2 1	W.	2	W. *b* f.	2	clou	clou	0 055
26	29 6	29 7	8 9	9 4	2 1	2 0	W. *b* f.	2	W. *b* f.	2	fair	fair	0 124
27	29 2	29 4	9 0	10 4	2 2	2 2	W.	1	W.	1	fog	fair	0 093
28	29 8	29 9	10 2	10 6	2 3	2 1	S. w.	0	S. w.	1	fog	clou	
29	29 6	29 6	11 7	10 7	2 1	1 9	S. w.	3	S. w.	2	clou	fair	
30	29 5	29 4	11 0	11 7	2 0	2 2	S. w.	3	S. w.	3	rain	fair	0 075
31	29 2	29 3	11 3	11 1	2 2	2 1	S. w.	3	W.	2	clou	clou	

Total Depth 3, 629

	Barom. In. D.	Ther In. D.	Hygr. In. D.
Height at a Medium	29 5	10 7	2 1
Greateft Height	30 2	12 6	2 8
Leaft Height	28 8	8 9	1 7

JANUARY, 1734.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
1	29 4	29 6	8 6	9 3	2 3	2 0	S. w.	3	W.	3	clou	clou	
2	29 6	29 4	9 6	9 3	2 0	2 1	S.	3	S. w.	2	clou	rain	
3	29 3	29 3	8 4	8 5	2 3	2 1	W.	2	W.	2	fair	fair	
4	29 2	29 2	8 3	8 3	2 2	2 1	S. w.	2	S. w.	2	fair	fair	
5	29 2	29 3	7 8	7 3	2 3	2 5	S. w.	2	S. w.	2	clou	clou	
6	29 6	29 6	7 4	7 7	2 0	1 9	W.	2	W.	1	fair	fair	0 085
7	29 7	29 8	7 1	7 7	1 9	2 6	W.	2	W.	1	fair	fog	
8	30 0	30 0	8 0	8 8	2 8	2 6	S. w.	1	S. w.	1	fog	fog	
9	30 0	30 0	9 0	9 3	9 0	9 3	S. *b* w.	1	S.	1	clou	clou	0 055
10	30 2	30 3	8 7	9 1	8 7		S.	1	S.	1	clou	clou	
11	30 5	30 5	7 7	7 5	1 8	1 7	S.	1	S.	1	fair	fair	0 095
12	30 5	30 6	7 0	7 6	1 7	1 6	S. w.	1	S. w.	1	fair	fair	
13	30 5	30 4	6 2	7 4	1 5	1 7	S. w.	1	S. w.	2	fair	fair	
14	30 2	30 1	7 0	7 4	2 0	2 2	S. w.	1	S. w.	1	fair	fair	
15	30 0	29 9	7 0	7 3	2 6	2 5	S. *b* e.	1	S. *b* e.	1	fog	fog	0 173
16	29 7	29 7	7 6	8 2	2 5	2 3	S.	1	S.	1	fair	fair	
17	29 8	30 0	8 0	8 5	2 5	2 4	S.	1	S. w.	1	fog	clou	
18	29 9	30 0	10 0	11 2	2 1	2 3	S. w.	3	S. w.	1	clou	clou	
19	30 0	30 1	10 7	10 5	2 3	2 1	S. w.	1	S. w.	2	clou	fair	
20	30 1	30 1	9 8	9 8	2 0	2 0	S. w.	1	S. w.	1	fair	fair	
21	30 0	29 8	8 9	10 0	2 0	1 9	S. w.	1	S. w.	1	fair	fair	
22	29 4	29 4	9 4	10 7	2 1	2 1	S. w.	2	W.	2	fair	fair	
23	29 8	29 8	9 5	10 4	1 9	1 2	W.	2	W.	2	fair	fair	
24	29 8	29 7	11 1	11 5	2 5	2 4	W.	2	W.	2	clou	rain	
25	29 6	29 3	10 4	9 9	2 1	2 1	W. *b* ſ.	3	W. *b* ſ.	3	clou	clou	0 065
26	29 8	29 9	10 5	10 8	2 0	1 8	N. w.	2	W.	3	clou	clou	
27	30 2	30 2	11 0	11 2	2 6	2 3	W.	2	W.	3	clou	fair	
28	30 2	30 2	10 7	11 4	2 5	2 4	S. w.	2	W.	2	fair	fair	0 045
29	30 3	30 3	11 0	11 8	2 5	2 5	W.	2	W. *b* ſ.	2	clou	clou	
30	30 3	30 2	11 2	11 2	2 5	2 3	W.	2	W.	2	clou	clou	0 075
31	30 2	30 2	10 2	9 4	2 1	1 5	W.	2	N. w.	3	fair	fair	

Total Depth 0, 593

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 9	8 8	2 2
Greateſt Height	30 6	11 5	2 8
Leaſt Height	29 2	6 2	1 2

FEBRUARY, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n	Hygrosc. Aft^n.	Wind. Forenoon.		Wind. Afternoon.		Weath.		Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	30 2	30 1	9 0	10 4	1 9	2 1	W. *b* f.	2	W.	3	fair	clou	
2	30 0	30 0	10 6	11 0	2 1	2 0	W.	4	W.	3	fair	fair	
3	29 9	29 7	10 8	11 2	2 3	2 2	S. w.	2	W.	3	fair	fair	
4	29 9	29 8	9 9	10 3	1 9	2 0	W.	3	W.	3	fair	clou	0 114
5	29 8	29 9	10 8	11 4	2 3	2 1	W.	2	W.	2	clou	clou	
6	29 8	29 6	10 9	11 0	2 2	2 0	S. w.	2	S. w.	3	clou	clou	
7	29 6	29 8	10 3	10 4	2 0	1 4	W. *b* n.	3	N. w.	3	fair	fair	0 094
8	30 3	30 3	9 9	10 5	1 6	2 0	W.	1	W.	2	clou	clou	
9	30 2	30 0	11 0	11 3	2 3	2 0	S. *b* w.	3	S. w.	2	clou	clou	
10	29 9	30 0	10 4	10 6	2 0	1 8	N. w.	3	N. w.	3	fair	fair	0 243
11	30 0	29 9	10 7	11 1	1 9	1 8	S. w.	2	S. w.	2	clou	clou	
12	29 6	29 6	11 7	11 8	2 0	1 7	S. w.	2	S. w.	1	clou	clou	
13	29 4	29 5	11 8	11 5	2 0	1 6	S. w.	2	S. w.	2	fair	fair	0 023
14	29 6	29 5	9 8	9 6	1 7	1 5	S. w.	2	S. w.	3	fair	clou	
15	28 8	28 6	10 5	10 2	2 0	2 0	S. *b* w.	4	S. w.	4	rain	clou	
16	29 0	29 0	9 2	9 4	2 0	2 0	S. w.	3	W.	2	fair	clou	
17	29 0	29 1	9 2	8 6	1 8	2 2	S. w.	3	S. w.	3	clou	clou	
18	29 0	29 5	9 9	10 4	2 1	1 5	N. w.	3	N.	4	clou	fair	
19	29 7	29 5	9 1	10 2	1 7	1 7	N. w.	2	W.	2	fair	rain	0 065
20	29 5	29 7	9 1	9 7	2 0	1 5	N. w.	3	N. w.	2	clou	fair	
21	29 9	29 9	9 1	9 6	1 9	2 0	W.	3	W.	2	clou	rain	
22	29 7	29 5	10 9	11 6	2 6	2 1	S. w.	2	S. w.	2	fair	clou	
23	29 3	29 3	10 9	11 5	2 1	1 7	S. w.	2	S. w.	2	clou	clou	
24	28 9	28 9	10 6	10 6	2 0	1 7	S. w.	2	W.	1	clou	fair	
25	29 0	29 1	10 1	10 8	2 2	2 1	S.	1	S.	1	clou	clou	0 056
26	29 3	29 3	9 6	10 8	2 1	2 0	S.	1	S.	1	fair	fair	
27	29 6	29 6	9 7	11 4	2 0	1 6	S. w.	0	S. w.	2	fair	clou	
28	29 4	29 5	11 4	12 2	1 8	1 5	S.	4	S. w.	3	clou	fair	

Total Depth 0, 595

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	10 5	1 9
Greatest Height	30 3	12 2	2 6
Least Height	28 6	8 6	1 4

MARCH, 1734.

Day.	Barom. For$^{n.}$	Barom. Aft$^{n.}$	Thermom. For$^{n.}$	Thermom. Aft$^{n.}$	Hygrosc. For$^{n.}$	Hygrosc. Aft$^{n.}$	Wind. Forenoon. Direct.	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 7	29 7	10 7	11 7	1 8	1 6	S.	1	S. e.	2	fair	fair	
2	29 6	29 6	10 7	11 4	1 7	2 0	S. *b* e.	1	S. e.	1	clou	fair	
3	29 6	29 6	11 5	11 9	2 1	1 8	S. w.	1	S. w.	1	clou	fair	
4	29 5	29 4	12 1	11 5	1 9	1 8	S.	2	S.	1	clou	clou	
5	29 5	29 4	11 2	11 6	1 8	1 6	S. w.	1	S. w.	1	rain	clou	
6	29 1	29 2	12 3	12 3	2 0	1 7	S. w.	3	S. w.	3	clou	fair	0 195
7	29 2	29 4	11 6	11 3	1 7	1 7	W.	3	W. *b* n.	3	fair	fair	
8	29 7	29 7	9 6	10 5	1 8	1 6	W. *b* n.	2	W. *b* n.	2	fair	clou	0 055
9	29 6	29 6	11 6	10 8	1 9	1 6	W.	2	W.	2	clou	clou	0 025
10	29 7	29 8	9 9	10 7	2 0	1 5	W. *b* n.	2	N. w.	2	fair	fair	0 048
11	29 8	29 6	9 9	11 1	1 8	1 9	S. e.	2	S.	2	fair	clou	0 036
12	29 6	29 7	10 8	10 7	1 8	1 6	S. w.	3	W.	3	rain	fair	0 095
13	29 5	29 3	9 8	10 6	1 7	1 9	S. e.	2	S. e.	1	fog	rain	
14	29 6	29 5	9 5	11 5	2 0	1 7	S. *b* e.	0	S. e.	0	fair	clou	0 172
15	29 4	29 6	10 4	11 3	2 0	1 4	W.	3	W. *b* n.	2	clou	fair	0 055
16	29 7	29 5	11 3	11 5	1 8	1 6	S. *b* w.	2	S. w.	4	clou	clou	0 026
17	29 8	29 8	9 6	10 8	1 8	1 3	S. w.	3	W. *b* f.	4	fair	clou	0 034
18	29 5	29 4	10 6	11 3	1 9	1 9	S. *b* w.	1	S. *b* w.	1	clou	clou	0 195
19	29 4	29 4	10 8	11 0	1 9	1 4	S. *b* e.	0	S. w.	1	fair	fair	0 075
20	29 2	29 1	12 2	12 5	1 8	1 9	S. e.	1	S. *b* w.	1	rain	clou	0 113
21	29 1	29 4	11 5	11 0	1 8	1 7	S. w.	1	W.	2	fair	fair	0 093
22	29 5	29 5	11 2	12 5	2 0	1 4	S. w.	2	S. w.	3	fair	clou	0 204
23	29 4	29 4	11 8	10 7	1 7	1 5	S. w.	4	S. w.	4	vari	rain	0 265
24	29 6	29 6	10 8	11 4	1 7	1 4	S. w.	3	S. w.	2	fair	clou	
25	29 6	29 6	10 6	11 5	1 7	1 3	S. w.	2	W. *b* f.	1	fair	fair	
26	29 3	29 1	11 3	11 4	1 7	1 8	S. w.	2	S. w.	1	clou	rain	0 210
27	29 4	29 5	11 3	11 4	1 6	1 4	N. w.	2	N. w.	2	fair	fair	0 034
28	29 7	29 6	9 6	11 0	1 6	1 5	N. w.	1	W.	1	fair	clou	
29	29 5	29 5	11 2	11 4	1 5	1 4	W. *b* n.	3	W. *b* n.	3	fair	fair	0 044
30	29 7	29 7	11 2	12 3	1 5	1 7	W. *b* n.	2	S. w.	3	fair	clou	0 085
31	29 8	29 9	12 4	12 4	2 1	1 7	W. *b* n.	3	W. *b* n.	2	clou	fair	0 063

Total Depth 2, 122

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 5	11 1	1 7
Greatest Height	29 9	12 5	2 1
Least Height	29 1	9 5	1 3

APRIL, 1734.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^n.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 9	29 9	12 3	12 8	2 0	1 7	S. w.	2	S. w.	3	clou	clou	
2	29 9	30 0	12 2	13 2	1 9	1 8	S. w.	3	W.	2	fair	clou	0 125
3	30 0	30 0	12 4	12 6	1 9	1 7	W.	2	W.	2	clou	clou	
4	29 9	29 9	12 3	13 7	2 0	1 5	W.	2	W.	2	fair	fair	
5	30 0	30 0	11 3	12 4	1 7	1 3	W.	2	N. e.	2	fair	fair	0 034
6	29 8	29 6	13 3	13 1	1 5	1 6	S. e.	0	S. w.	2	clou	clou	
7	29 6	29 6	10 9	11 1	1 5	1 7	W.	2	W.	3	fair	fair	
8	29 6	29 5	11 5	11 7	1 8	1 5	S. w.	2	W. *b* n.	2	clou	fair	
9	29 5	29 6	10 5	11 9	1 6	1 2	W. *b* n.	3	N. w.	3	fair	fair	
10	29 8	29 8	12 1	12 4	2 0	1 5	W. *b* ſ.	3	W.	3	clou	clou	
11	29 9	30 0	11 4	11 6	1 6	1 4	W.	2	W.	4	fair	vari	
12	30 0	30 0	11 8	12 7	1 5	1 5	W. *b* ſ.	2	S. w.	3	clou	clou	
13	30 1	30 2	13 2	13 7	1 9	1 5	W.	2	W. *b* ſ.	2	fair	fair	0 055
14	30 2	30 1	12 7	14 7	1 9	1 4	W. *b* ſ.	1	S. *b* e.	1	fair	fair	
15	30 0	29 9	12 5	14 0	1 8	1 3	S. e.	1	S. e.	1	fair	fair	
16	29 9	29 9	12 3	13 4	1 8	1 3	S. e.	1	E.	0	fair	fair	
17	29 9	29 9	11 7	11 8	1 9	1 6	E. *b* n.	2	N. e.	2	fair	fair	
18	29 7	29 8	10 7	11 5	2 4	1 8	E.	3	E.	2	clou	clou	0 137
19	30 0	30 0	11 5	11 2	1 9	1 8	E.	2	E.	2	fair	clou	0 204
20	30 0	30 0	11 5	11 1	2 6	2 0	E.	2	E.	2	clou	fair	0 055
21	30 0	29 9	11 5	12 6	1 6	1 4	E.	1	E.	1	fair	fair	
22	29 9	29 9	9 9	9 4	1 8	2 1	N. e.	2	E.	1	clou	rain	0 045
23	29 8	29 8	11 3	11 4	2 0	1 8	E.	1	E.	2	clou	fair	
24	29 7	29 6	11 4	11 6	2 0	2 1	S. e.	2	S. e.	2	clou	clou	
25	29 5	29 6	12 7	13 0	2 3	1 6	S. e.	1	W.	1	fair	clou	
26	29 5	29 5	13 5	13 1	1 6	1 4	S. w.	2	W.	2	fair	fair	0 056
27	29 5	29 5	12 6	13 0	1 6	1 6	S. w.	2	W.	1	fair	clou	0 084
28	29 5	29 5	12 4	13 5	1 6	1 3	W.	2	S. w.	2	fair	fair	0 095
29	29 5	29 4	13 5	13 6	1 3	1 4	S. w.	2	S. w.	1	fair	rain	0 116
30	29 4	29 4	12 6	12 4	1 4	1 4	S. w.	2	S. w.	2	fair	clou	

Total Depth 1, 006

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	12 2	1 7
Greateſt Height	30 2	14 7	2 6
Leaſt Height	29 4	9 4	1 2

MAY, 1734.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 4	29 4	12 2	12 0	1 3	1 5	S. w.	2	S. w.	2	clou	rain	
2	29 7	29 7	9 8	10 8	1 7	1 4	N. e.	2	N. e.	2	fair	fair	0 066
3	29 8	29 8	10 4	11 6	1 7	1 2	N.	2	N. *b* w.	2	clou	fair	
4	29 8	29 9	11 0	12 3	1 4	1 0	N. w.	2	N. w.	2	fair	fair	
5	30 0	29 9	11 2	12 6	1 2	1 6	W.	1	W.	2	fair	clou	0 057
6	29 7	29 8	11 9	11 2	1 5	1 5	W.	2	W.	1	clou	clou	
7	29 7	29 6	11 4	10 8	1 5	1 7	W.	1	N. e.	1	clou	clou	
8	29 7	29 8	12 0	13 1	1 6	1 3	E.	2	E.	2	fair	fair	0 127
9	30 0	30 1	11 8	12 7	1 4	1 6	N. e.	2	N. e.	2	fair	fair	0 055
10	30 0	29 9	12 0	12 8	1 5	1 3	W. *b* n.	3	N. w.	3	clou	fair	
11	29 7	29 4	12 2	12 4	1 5	1 5	W.	4	W.	3	clou	clou	
12	29 4	29 3	11 5	12 6	1 4	1 0	N. w.	3	N. w.	3	fair	clou	
13	29 4	29 4	11 0	11 9	1 3	1 2	N. w.	3	S.	1	fair	hail	
14	29 4	29 4	11 0	11 3	1 4	1 3	E.	2	E.	2	fair	fair	0 185
15	29 5	29 5	10 6	11 7	1 4	1 3	N. w.	1	N.	1	fair	clou	0 205
16	29 6	29 6	11 9	11 9	1 5	1 5	E. *b* ſ.	1	E.	1	clou	rain	0 113
17	29 6	29 6	11 2	12 6	1 3	1 2	N. w.	1	E.	1	fair	fair	0 130
18	29 5	29 5	12 6	12 2	1 4	1 4	N. e.	1	S. w.	2	fair	fair	
19	29 5	29 6	11 8	11 9	1 3	1 2	S. w.	2	S. w.	1	fair	fair	0 245
20	29 8	29 8	12 3	13 0	1 7	1 4	W.	2	W.	2	clou	clou	0 070
21	29 8	29 6	13 9	12 6	1 4	1 7	S.	1	S. w.	2	fair	clou	0 120
22	29 4	29 4	13 1	13 1	1 7	1 4	S. w.	1	S. w.	1	clou	clou	0 398
23	29 6	29 7	12 2	12 5	1 5	1 3	W.	2	W.	2	fair	fair	0 127
24	29 8	29 8	13 2	13 7	1 5	1 3	W.	1	E.	1	clou	fair	0 088
25	29 8	29 7	12 8	11 9	1 5	1 6	E.	2	E.	2	fair	clou	0 034
26	29 6	29 7	11 7	11 7	2 0	2 1	N. e.	2	N. e.	2	clou	clou	
27	29 7	29 7	12 0	13 0	1 8	1 6	N. e.	1	E.	1	fair	fair	
28	29 7	29 7	13 6	13 3	2 0	1 3	N. e.	1	S. e.	1	fair	clou	0 155
29	29 6	29 6	12 7	12 2	1 2	2 2	E.	1	E.	1	clou	clou	0 085
30	29 5	29 5	12 2	13 0	3 5	2 6	E. *b* n.	2	E. *b* n.	2	clou	clou	0 840
31	29 5	29 6	12 3	11 8	2 4	3 3	N. e.	3	N. e.	3	rain	rain	0 213

Total Depth 3, 313

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	12 1	1 5
Greatest Height	30 1	13 9	3 5
Least Height	29 3	9 8	1 0

JUNE, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 7	29 7	12 8	13 1	3 0	2 1	N. e.	0	E.	1	clou	clou	0 988
2	29 7	29 7	13 4	12 6	2 2	2 7	S. e.	0	E. *b* ſ.	0	rain	rain	0 084
3	29 7	29 7	13 5	14 0	2 0	1 5	S. w.	1	W.	1	fair	fair	0 135
4	29 8	29 8	13 6	14 9	1 6	1 4	W.	0	W.	1	fair	fair	0 075
5	29 8	29 9	12 7	13 6	2 0	1 6	N.	0	N. e.	0	fair	clou	0 056
6	29 9	29 8	12 4	12 5	1 8	1 5	E.	2	E.	2	clou	clou	
7	29 8	29 8	11 9	12 9	1 4	1 3	N. e.	2	E.	1	fair	fair	0 044
8	29 9	29 9	12 3	12 1	1 5	1 5	E.	2	E.	2	fair	fair	
9	29 9	29 9	13 1	12 6	1 4	1 4	E.	1	E.	1	fair	clou	
10	30 0	30 0	13 2	13 1	1 4	1 4	E.	2	E.	2	fair	clou	
11	30 0	30 0	13 0	14 1	1 5	1 6	S. e.	0	S. e.	0	clou	fair	
12	30 0	30 0	14 8	15 7	1 5	1 3	N. w.	1	N. w.	1	fair	fair	
13	29 9	29 9	14 5	14 8	1 7	1 5	E.	0	E.	1	fair	fair	
14	29 9	29 8	13 2	13 2	2 2	1 9	N. e.	3	N. e.	2	fair	fair	
15	29 7	29 7	12 7	12 8	2 7	2 8	N. e.	2	N. e.	2	clou	fair	
16	29 7	29 8	13 7	13 6	1 6	1 7	N. e.	2	N. e.	2	fair	clou	
17	29 9	29 9	12 9	14 1	1 9	1 7	N. e.	2	N. e.	2	clou	fair	0 035
18	30 0	30 0	15 0	16 5	1 8	1 3	S. e.	1	S.	1	fair	fair	
19	30 0	29 9	16 8	17 4	1 4	1 3	S.	0	S. e.	2	fair	fair	
20	29 8	29 8	15 2	15 6	1 4	1 2	S. e.	1	S. e.	1	fair	fair	
21	29 8	29 7	14 3	13 7	2 0	2 5	N. e.	2	N. e.	2	fair	fog	
22	29 7	29 7	14 8	14 6	3 1	2 0	N. w.	1	S. w.	0	clou	fair	
23	29 7	29 7	13 6	12 7	3 0	3 2	N. e.	2	N. e.	2	fog	fog	0 455
24	29 7	29 7	12 2	12 1	3 7	3 3	N. e.	3	N. e.	1	clou	clou	0 234
25	29 6	29 6	13 1	13 9	3 0	2 6	E.	0	E.	0	clou	fair	0 035
26	29 6	29 7	13 9	14 7	2 3	1 7	W.	1	W.	1	fair	fair	
27	29 8	29 8	14 4	15 0	1 8	1 5	W.	1	W.	1	fair	fair	
28	29 8	29 9	14 6	14 8	1 4	1 3	W.	2	W.	2	fair	fair	0 044
29	29 9	29 9	14 7	15 6	1 5	1 2	W.	2	W.	1	fair	fair	
30	29 7	29 5	14 3	14 4	1 7	1 8	S.	1	S.	1	clou	clou	0 025

Total Depth 2, 210

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	13 8	1 8
Greateſt Height	30 0	17 4	3 7
Leaſt Height	29 5	10 1	1 2

JULY, 1734.

Day.	Barom. Forn. I. D.	Barom. Aftn. I. D.	Thermom. Forn. I. D.	Thermom. Aftn. I. D.	Hygrosc. Forn. I. D.	Hygrosc. Aftn. I. D.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo	Weath. Fo.	Weath. Af	Rain. In. D.
1	29 6	29 6	13 3	14 2	1 8	1 5	W.	3	W.	3	fair	fair	
2	29 6	29 7	13 3	13 5	1 6	1 7	W.	3	N. w.	2	fair	fair	
3	29 9	30 0	14 6	14 5	1 5	1 5	N.	1	N. e.	1	fair	fair	0 050
4	30 1	30 1	14 4	14 7	1 4	1 3	N. e.	2	N.	1	fair	fair	
5	30 1	30 1	15 4	15 4	1 3	1 3	N.	0	N. w.	1	fair	fair	
6	30 1	30 1	14 6	14 8	1 5	1 3	W.	1	W.	1	fair	fair	
7	30 0	30 0	14 5	14 6	1 8	1 4	E.	1	E.	1	clou	fair	
8	30 1	30 1	14 6	15 0	1 7	1 4	E.	1	E.	1	fair	fair	0 114
9	30 0	30 0	15 6	15 3	1 6	1 5	S. e.	1	S. e.	1	fair	fair	0 056
10	30 0	30 0	15 3	16 4	1 8	1 5	N. w.	1	N. w.	1	clou	fair	
11	29 9	29 9	15 5	15 4	1 4	1 4	W.	2	S. w.	2	clou	clou	
12	29 7	29 6	15 3	14 7	1 4	1 5	W.	2	S. w.	1	fair	rain	
13	29 4	29 4	14 6	15 5	1 7	1 3	S. w.	2	S. w.	2	fair	fair	0 074
14	29 3	29 3	14 9	13 1	1 4	2 0	W.	2	N.	2	clou	rain	
15	29 6	29 7	12 6	13 6	1 9	1 3	N. w.	1	N. w.	1	clou	clou	
16	29 5	29 5	14 6	14 8	1 8	1 4	S. w.	2	W.	2	clou	clou	
17	29 5	29 6	13 9	13 7	1 6	1 6	W.	1	E.	1	fair	clou	
18	29 8	29 9	12 6	13 7	1 6	1 3	E.	2	E.	2	fair	fair	0 030
19	29 9	29 8	14 3	15 3	1 4	1 2	W.	2	S. w.	2	fair	clou	
20	29 6	29 7	13 7	14 0	1 5	1 4	W.	3	W.	3	clou	clou	0 053
21	29 7	29 7	14 4	14 6	1 6	1 6	N. w.	2	N. w.	2	clou	clou	
22	29 9	29 9	14 7	15 6	1 8	1 6	W.	2	N. w.	2	fair	fair	
23	29 9	29 9	15 3	16 5	1 5	1 5	N. w.	2	W.	2	fair	fair	
24	29 8	29 8	16 0	15 3	1 9	1 6	N. b w.	1	N. w.	1	fog	clou	
25	29 8	29 8	15 6	15 0	1 6	1 7	W.	1	W.	1	fair	fair	0 190
26	29 5	29 5	15 1	15 0	2 6	1 9	S. e.	1	S. e.	2	haz	rain	0 020
27	29 4	29 3	14 3	15 0	2 4	2 1	E.	2	E.	1	fog	clou	
28	29 3	29 4	14 1	13 5	3 0	3 5	E.	1	E.	1	rain	fog	
29	29 5	29 6	13 7	14 6	3 8	2 9	E.	1	E.	0	fog	clou	0 076
30	29 7	29 8	14 3	14 1	2 7	2 5	E.	2	E.	1	fair	fair	
31	29 8	29 8	13 6	14 2	2 7	2 1	E.	1	E.	1	clou	clou	0 046

Total Depth 0, 709

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	14 1	1 7
Greatest Height	30 1	16 5	3 8
Least Height	29 3	12 6	1 2

AUGUST, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 7	29 8	13 7	14 3	2 6	2 7	W.	2	E.	2	clou	rain	
2	30 0	30 0	12 6	14 2	1 9	1 5	W. *b* n.	2	N. w.	2	fair	fair	0 045
3	30 0	30 1	13 0	14 7	1 8	1 5	N. w.	2	N. e.	2	fair	fair	0 090
4	30 0	29 9	14 0	15 6	1 7	1 5	N. w.	2	W. *b* n.	2	fair	fair	0 180
5	29 9	29 9	14 4	14 5	2 3	2 2	N. w.	2	W.	2	haz	clou	
6	29 8	29 9	14 9	14 6	1 6	1 6	W.	1	W.	1	haz	haz	0 260
7	29 7	29 7	14 5	14 4	1 7	1 9	S. w.	2	W.	2	clou	clou	
8	29 7	29 7	13 5	14 3	1 7	1 4	W.	1	W.	1	fair	fair	
9	29 6	29 5	13 8	14 7	2 1	2 6	E.	1	E.	1	haz	fog	0 340
10	29 2	29 0	14 4	12 7	3 0	4 9	E.	1	N.	1	haz	rain	0 115
11	29 1	29 2	12 5	12 9	3 0	2 5	W.	2	W.	2	rain	rain	
12	29 6	29 7	13 5	13 6	2 2	1 8	W.	2	W.	1	fair	clea	
13	29 7	29 6	13 3	13 8	2 0	1 7	W.	1	S. w.	1	fair	fair	
14	29 7	29 6	13 7	14 0	1 8	1 6	S. w.	1	S. ſ. w.	1	fair	clou	
15	29 6	29 6	13 9	14 3	2 0	1 5	S. w.	1	W.	1	clou	clou	0 090
16	29 6	29 6	13 7	14 0	1 8	1 6	W.	2	W.	1	fair	fair	
17	29 7	29 7	13 5	13 7	2 0	1 8	N. e.	2	N. e.	1	fair	fair	0 050
18	29 8	29 9	13 5	13 6	1 8	1 7	S. w.	2	S. w.	1	fair	fair	
19	29 6	29 7	13 7	13 6	1 7	1 7	W.	2	S. w.	2	clou	fair	
20	29 8	29 9	13 3	12 7	1 7	1 5	W. *b* ſ.	2	W.	1	fair	fair	
21	30 1	30 1	12 8	13 6	1 7	1 7	W.	1	E.	1	fair	clou	
22	29 9	29 8	13 7	13 6	1 9	1 9	S. e.	2	S. *b* e.	1	clou	rain	
23	29 6	29 4	14 0	14 4	2 5	2 1	S. e.	1	S. w.	1	rain	rain	
24													
25	29 5	29 5	13 8	14 4	1 9	1 5	W.	2	W. *b* ſ.	2	fair	fair	0 060
26	29 3	29 4	14 8	13 1	1 7	1 8	W. *b* ſ.	3	W.	3	clea	clea	0 020
27	29 7	29 7	13 5	13 2	1 9	1 8	W.	3	W.	1	clou	clou	
28	29 8	29 7	13 5	13 0	2 1	1 9	W.	1	E.	1	fair	rain	
29	29 4	29 4	12 7	13 8	2 7	1 5	S. e.	2	E. *b* ſ.	1	rain	clou	
30	28 9	28 8	13 3	13 1	2 1	1 8	S. w.	1	S. w.	1	fair	clou	0 035
31	28 7	28 8	13 8	13 9	1 9	1 9	S. w.	1	S. w.	2	fair	clou	

Total Depth 1, 285

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	13 3	1 9
Greateſt Height	30 1	15 6	4 9
Leaſt Height	28 7	12 5	1 4

SEPTEMBER, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind Forenoon Direct.	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	28 9	29 2	13 3	12 0	1 9	1 9	W.	2	W.	2	fair	fair	0 025
2	29 4	28 9	12 7	11 8	1 8	1 2	W.	3	W.	3	fair	rain	
3	28 9	28 9	11 8	12 3	1 7	1 6	W.	3	S. w.	3	fair	fair	
4	29 3	29 5	12 7	13 0	1 5	1 5	N. w.	3	N. w.	2	fair	fair	0 078
5	29 6	29 7	12 9	12 8	2 3	2 1	W.	1	W.	1	clou	fair	
6	29 8	29 7	12 8	12 7	1 9	1 7	S. e.	2	W.	1	clou	rain	
7	29 8	29 9	13 5	12 7	2 4	1 6	W.	2	W.	2	fair	fair	
8	29 9	29 8	12 5	13 1	1 9	1 8	S. w.	2	S. w.	1	clou	clou	
9	29 6	29 7	11 3	11 3	2 3	1 7	N. e.	2	N.	2	rain	fair	0 130
10	29 8	30 0	11 6	11 2	1 6	1 5	N. w.	2	N. w.	2	fair	fair	0 065
11	30 0	30 0	11 6	12 5	1 6	1 7	N. w.	1	W. *b* f.	1	clou	clou	0 090
12	30 0	30 0	12 3	13 2	1 8	1 5	S. w.	1	S. w.	1	clou	clou	
13	30 0	29 9	12 3	12 5	1 8	1 6	W.	1	W.	1	fair	clou	
14	29 8	29 8	11 7	12 4	1 9	1 5	W.	2	N. w.	2	fair	fair	
15	29 8	29 8	12 1	12 8	1 8	1 9	W.	2	W.	2	clou	clou	
16	29 8	29 9	12 1	12 1	2 0	1 7	W.	1	W.	1	fair	fair	0 156
17	29 9	29 9	12 8	14 4	1 8	1 7	S.	2	S. w.	2	clou	fair	
18	30 0	30 0	13 8	14 1	1 9	1 7	S. w.	3	S. w.	2	fair	clou	0 260
19	30 0	29 9	12 5	11 3	2 9	1 1	W.	1	W.	1	clou	clou	
20	29 7	29 6	11 8	12 0	2 9	2 8	S. w.	1	S. w.	1	fair	clou	0 127
21	29 4	29 2	11 9	11 9	2 0	1 8	S. w.	1	S. w.	1	fair	fair	
22	28 7	28 8	10 7	11 9	1 9	1 9	W.	3	W.	2	rain	clou	
23	29 4	29 5	11 2	11 8	1 7	1 7	N. w.	2	W.	1	fair	rain	
24	29 3	29 3	12 5	11 2	2 2	1 9	N. w.	1	N.	1	fair	clou	
25	29 7	29 9	10 7	11 1	2 0	1 6	N.	2	N.	2	fair	fair	0 090
26	30 0	29 9	10 1	11 0	1 7	1 8	W. *b* n.	2	W.	2	clou	clou	0 035
27	29 8	29 8	12 0	11 8	2 6	1 9	N. e.	1	E. *b* n.	1	clou	clou	
28	29 7	29 7	11 6	12 2	1 9	1 7	E.	1	E.	1	fair	fair	
29	29 7	29 7	11 6	10 0	1 8	1 8	W.	2	W.	2	clou	clou	0 116
30	29 3	29 3	9 9	10 6	2 2	2 0	S. w.	3	S. w.	1	rain	clou	

Total Depth 1, 172

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 6	12 0	1 8
Greatest Height	30 0	14 4	2 9
Least Height	28 7	9 9	1 2

OCTOBER, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom For^n.	Thermom Aft^n.	Hygrosc. For^n	Hygrosc. Aft^n.	Wind. Forenoon. Direct	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D	I. D.	I. D	I. D.							In. D.
1	28 8	28 8	12 4	11 0	2 2	2 0	S. w.	4	S. w.	2	rain	fair	
2	28 8	29 1	11 4	11 6	1 9	1 7	S. w.	3	S. w.	2	fair	fair	
3	29 1	29 0	10 6	10 4	1 9	2 2	S. w.	1	N. w.	0	fog	clou	0 096
4	29 3	29 4	10 6	11 2	2 2	2 1	S.	0	S.	1	fair	fair	
5	29 5	29 5	11 2	11 5	2 3	2 1	N.	1	N.	0	clou	clou	
6	29 5	29 3	11 6	11 6	3 0	2 4	E.	1	E.	1	fog	clou	0 107
7	29 1	29 2	10 4	10 7	3 1	3 2	N. e.	1	N.	2	rain	low	0 037
8	29 5	29 5	10 6	10 5	2 6	1 8	W.	2	W.	2	clou	clou	
9	29 4	29 4	10 5	10 0	2 2	2 2	W.	3	W.	2	clou	clou	
10	29 5	29 6	10 2	10 4	2 4	2 0	W.	3	S. w.	2	fair	clou	0 130
11	29 5	29 3	10 3	10 6	2 3	2 3	S.	1	S.	2	clou	rain	
12	29 1	29 1	9 9	10 8	2 3	2 0	S.	1	S.	1	fair	fair	
13	29 1	29 2	10 6	11 0	2 2	1 9	S e.	1	N. e.	2	fair	clou	
14	29 5	29 6	10 3	10 4	3 0	2 9	N.	0	N.	0	clou	fair	0 090
15	29 6	29 6	10 7	10 4	2 9	2 7	N. e.	0	N. e.	1	fair	clou	0 030
16	29 6	29 7	9 4	10 2	2 5	2 2	N. w.	2	N. w.	2	fair	fair	0 290
17	29 9	29 9	9 7	10 3	2 3	2 0	N. w.	2	N. *b* w.	1	fair	fair	
18	30 0	29 9	9 2	10 6	2 1	2 0	N. w.	1	N. w.	1	fair	clou	
19	30 0	30 1	9 5	9 3	2 0	2 0	N.	4	N. e.	2	fair	fair	
20	30 0	30 0	9 5	9 2	2 0	1 9	W.	2	W. *b* n.	0	clou	clou	0 075
21	30 0	30 0	10 2	10 3	2 6	2 8	N. w.	1	N. w.	1	haz	clou	
22	30 2	30 2	9 5	10 0	2 6	2 4	W.	1	W.	1	fair	fair	
23	30 1	30 0	10 0	10 8	2 6	2 6	W.	2	W.	2	fair	clou	
24	29 9	29 8	11 8	12 2	3 0	3 0	W.	2	W. *b* ſ.	1	rain	clou	
25	30 0	29 9	10 9	11 5	2 5	2 8	S. w.	3	S. w.	3	clou	clou	
26	29 8	29 7	11 3	11 0	2 0	1 9	N. w.	4	N. w.	4	fair	clou	0 179
27	29 7	29 8	9 5	9 3	1 8	1 6	N. w.	3	N. w.	3	fair	clou	0 094
28	29 8	29 8	9 0	9 8	1 7	1 6	N. w.	2	N. w.	1	fair	clou	0 055
29	29 5	29 4	9 3	9 4	2 2	2 3	S. w.	0	S. w.	1	fog	fair	
30	29 5	29 6	9 3	9 8	2 3	2 0	S. w.	2	S. w.	2	fair	fair	0 085
31	29 4	29 3	10 9	11 5	2 1	2 0	S. w.	1	S. e.	1	clou	clou	0 053

Total Depth 1, 321

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 5	10 3	2 2
Greateſt Height	30 2	12 4	3 2
Leaſt Height	28 8	9 0	1 6

NOVEMBER, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.	In. D.
1	29 7	29 9	9 3	10 4	2 0	2 0	S. w.	1	S. w.	0	fair	fair	
2	30 0	30 0	10 3	10 7	2 1	2 0	S.	1	S.	1	fair	fair	0 130
3	29 8	29 9	11 6	10 8	2 1	2 1	S.	1	S.	1	clou	fair	0 070
4	29 8	29 7	10 4	10 6	2 1	2 0	S.	1	S.	2	clou	fair	
5	29 8	29 8	10 4	10 5	2 1	2 1	S. w.	2	S. w.	2	fair	fair	
6	29 9	29 9	10 2	10 6	2 3	2 1	S. w.	1	S. *b* w.	1	clou	clou	
7	29 8	29 9	10 6	10 1	2 0	2 0	S. w.	1	S. w.	1	clou	fair	
8	30 2	30 2	9 0	9 0	2 3	2 2	S. w.	1	S. w.	1	frost	fair	
9	30 2	30 2	9 1	9 3	2 5	2 7	S. w.	1	S. w.	1	mist	fair	0 180
10	30 2	30 2	8 5	8 6	2 3	2 2	S. w.	1	S. w.	1	frost	frost	0 075
11	30 2	30 2	8 2	8 2	2 1	2 1	S. w.	1	S. w.	1	fair	fair	
12	30 2	30 3	7 9	8 3	2 2	2 1	S. w.	1	S. w.	1	frost	frost	0 094
13	30 4	30 4	8 2	8 9	2 4	2 4	S. w.	1	S. w.	1	fog	clou	
14	30 4	30 4	9 0	9 4	2 5	2 2	S. *b* e.	1	S. *b* e.	1	fog	fog	
15	30 4	30 4	9 5	9 8	2 1	2 0	S. e.	1	S. e.	1	fog	fog	
16	30 4	30 3	9 4	9 2	2 0	2 0	S. e.	1	S. w.	1	clou	clou	
17	30 2	30 2	9 2	9 1	2 0	2 0	W.	1	W.	2	clou	clou	0 144
18	30 1	30 0	8 1	8 9	2 3	2 2	W.	1	W.	1	fair	fair	0 090
19	29 9	29 9	9 2	9 4	2 5	2 3	S.	1	S. *b* e.	1	fog	fog	
20	29 8	29 7	8 8	9 3	2 2	2 3	S. w.	1	S. w.	1	fog	fog	
21	29 7	29 7	8 7	9 5	2 3	2 3	W.	1	W.	1	fair	clou	
22	29 5	29 5	8 6	8 5	2 3	2 2	S. w.	2	W.	2	fair	fair	0 385
23	29 4	29 3	7 8	8 5	2 2	2 3	W.	0	S. e.	1	fog	fog	
24	29 4	29 5	9 0	9 0	1 9	1 6	N. e.	2	N. e.	2	clou	clou	0 130
25	29 7	29 8	8 1	8 6	2 6	2 2	S. e.	1	S. e.	1	sno	clou	
26	29 9	30 0	8 3	7 9	2 4	2 0	N.	3	N.	2	fair	fair	0 150
27	30 2	30 2	7 7	7 9	2 0	2 0	W.	1	W.	1	frost	frost	
28	29 6	29 7	10 3	11 2	2 3	1 6	S. w.	3	S. w.	2	rain	fair	0 090
29	29 6	29 6	11 6	11 7	2 6	2 7	S. w. *b* w.	2	S. w. *b* w.	2	fair	clou	0 070
30	29 7	29 5	9 6	10 5	2 6	2 3	W.	2	W.	2	fair	clou	

Total Depth 1, 608

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 9	9 3	2 1
Greatest Height	30 4	11 7	2 7
Least Height	29 3	7 7	1 6

DECEMBER, 1734.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Forenoon. fo.	Wind. Afternoon. Direct.	Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 1	28 9	11 5	11 5	2 3	2 3	S. w.	3	S. w.	2	clou	clou	0 094
2	29 0	29 1	8 7	8 8	2 3	2 2	S. w.	2	S. w.	2	fair	fair	0 067
3	29 1	29 1	8 3	8 8	2 3	2 3	S. *b* e.	2	S. *b* e.	1	fair	fair	
4	29 2	29 2	8 0	8 4	2 4	2 3	S.	1	S.	1	fog	clou	0 190
5	28 9	28 9	9 1	9 5	2 5	2 8	E.	2	E.	2	fog	rain	0 050
6	29 1	29 2	9 5	9 7	3 0	3 0	W.	2	W.	2	clou	haz	
7	29 3	29 5	9 0	8 8	2 8	2 5	W. *b* n.	2	N. w.	2	fair	fair	0 090
8	29 4	29 3	9 0	10 1	2 6	2 4	S. w.	1	S. w.	2	clou	clou	
9	29 0	29 2	10 0	9 6	2 5	2 4	S. w.	2	S. w.	2	fair	fair	
10	29 3	29 3	8 9	9 5	2 3	2 3	S.	3	S.	2	fair	fair	
11	28 8	29 0	8 5	8 8	2 8	2 3	N. w.	3	N. w.	3	clou	fair	0 156
12	29 2	29 1	9 3	9 2	2 4	2 3	S.	1	S.	1	fair	fair	0 060
13	28 6	28 6	9 4	9 4	3 0	2 8	S. e.	1	S. e.	2	fog	clou	0 075
14	28 0	28 0	9 1	9 1	2 6	2 3	S.	2	S.	2	haz	clou	
15	28 3	28 6	9 3	9 1	2 2	2 5	N. e.	2	N. e.	2	fair	rain	
16	29 0	29 1	8 4	8 8	2 3	2 5	W. *b* n.	2	W. *b* n.	2	fair	fair	0 460
17	28 9	28 9	8 6	9 0	2 5	2 5	S. e.	1	S. e.	1	fog	haz	0 205
18	28 9	28 9	9 0	8 9	2 5	2 3	S. w.	2	S. w.	2	clou	fair	0 240
19	29 0	29 1	9 5	9 8	2 3	2 3	S. w.	3	S. w.	3	clou	fair	
20	29 5	29 6	9 3	9 2	2 5	2 5	S. w.	2	S. w.	1	fair	fair	
21	29 6	29 6	8 6	8 8	2 3	2 6	S. w.	2	S. w.	2	fog	clou	
22	29 8	29 8	7 9	8 5	2 5	2 6	W.	1	W.	1	fair	fog	
23	29 8	29 8	7 4	8 1	2 8	2 7	S. *b* e.	2	S. *b* e.	1	fair	fog	
24	29 6	29 5	10 6	10 3	2 7	2 7	S. w.	2	S. w.	2	clou	clou	0 385
25	29 7	29 7	8 3	8 8	2 5	2 5	W.	2	W.	2	fair	fair	0 090
26	29 5	29 1	9 9	10 7	2 3	2 3	S. *b* w.	4	S. *b* w.	4	clou	clou	
27	29 3	29 1	9 2	10 0	2 2	2 2	S. *b* w.	3	S. *b* w.	3	fair	clou	
28	28 6	28 9	9 9	10 2	2 6	2 0	S. *b* w.	2	W. *b* n.	3	fair	clou	
29	29 0	29 0	8 8	9 0	2 2	2 2	S. *b* e.	1	S. *b* e.	1	fog	clou	0 170
30	29 5	29 8	8 3	9 0	2 3	1 9	S. *b* w.	1	S. *b* w.	2	fair	fair	
31	29 6	29 8	9 6	9 0	2 1	2 3	S. w.	4	S. w.	2	clou	clou	

Total Depth 2, 332

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 0	9 1	2 4
Greatest Height ———	29 8	11 5	3 0
Least Height ———	28 0	7 4	1 9

JANUARY, 1735.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrofc. For^n.	Hygrofc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain. In. D.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							
1	29 9	30 0	9 2	9 3	2 3	2 3	W. *b* ſ.	2	W.	2	fair	fair	
2	29 8	29 6	10 7	11 5	2 3	2 3	S. w.	4	S. w.	4	clou	rain	0 147
3	29 9	29 9	9 0	9 7	2 3	2 3	S. w.	3	W.	3	fair	clou	
4	30 2	30 2	9 0	10 5	2 3	2 2	W.	3	S. w.	3	fair	clou	0 096
5	30 0	29 8	11 1	11 3	2 6	2 6	S. *b* w.	3	W.	4	clou	clou	
6	29 6	29 3	11 4	11 6	2 6	2 4	W.	3	S. w.	4	clou	rain	
7	28 7	28 6	8 7	9 1	2 1	2 2	S. w.	4	W.	3	fair	clou	
8	28 4	28 2	8 3	8 5	2 3	2 3	S.	1	N.	1	fog	fair	
9	28 4	28 6	8 3	8 4	2 7	2 6	W.	1	W.	2	fair	fair	0 195
10	28 9	28 9	7 8	7 6	2 5	2 4	W.	2	W.	1	fair	fog	
11	28 9	29 0	8 8	8 7	2 5	2 7	E.	2	N.	2	clou	clou	
12	29 5	29 5	7 7	8 0	2 2	2 0	N. w.	2	N. w.	2	fair	fair	0 540
13	29 3	29 0	7 9	8 2	2 0	2 1	S.	2	S. e.	3	ſno	clou	0 430
14	28 6	28 7	8 8	8 5	2 2	2 0	W. *b* n.	4	W. *b* n.	3	clou	clou	
15	29 1	29 2	9 1	9 2	2 2	2 3	W.	3	W.	2	fair	fair	
16	29 3	29 3	8 4	8 6	2 6	2 5	S. w.	2	W.	2	fair	fair	
17	29 5	29 5	8 5	9 3	2 5	2 3	W.	2	W.	2	fair	clou	0 290
18	29 2	29 1	9 8	10 6	2 5	2 6	S. w.	2	S. w.	2	clou	clou	0 057
19	29 2	29 3	9 5	9 5	2 5	2 5	W.	2	N.	3	clou	clou	
20	29 7	29 8	8 7	8 2	2 3	2 2	N.	2	N.	2	clou	fair	
21	29 9	29 8	8 6	8 7	2 0	2 0	W. *b* n.	2	S. w.	2	fair	clou	0 250
22	29 8	29 9	8 1	8 6	2 3	2 2	W.	2	N.	2	fair	fair	
23	29 8	29 8	8 4	8 3	2 1	1 9	E.	2	E.	2	fog	clou	
24	29 8	29 8	8 0	8 8	1 9	2 0	N. w.	2	N. w.	2	fair	fair	0 410
25	29 8	30 1	3 8	8 6	2 3	1 9	W.	2	W.	2	clou	clou	0 160
26	30 0	29 9	9 7	10 6	2 6	2 7	W.	2	W.	2	fair	clou	
27	29 9	29 9	9 7	10 0	2 6	2 2	W.	2	W.	2	fair	fair	0 130
28	29 9	30 2	10 8	9 6	2 3	2 5	W.	3	E.	2	clou	rain	
29	30 3	30 2	9 6	10 1	2 4	2 4	W.	2	W.	2	clou	fair	
30	30 2	30 1	9 9	10 4	2 8	2 5	W.	2	W.	2	fair	clou	0 290
31	30 2	30 3	9 7	10 6	3 0	2 3	W.	2	W.	2	fair	fair	

Total Depth 2, 995

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium ———	29 5	9 2	2 7
Greateſt Height ———	30 3	11 6	3 0
Leaſt Height ———	28 2	7 6	1 9

FEBRUARY, 1735.

Day.	Barom. Forn.	Barom. Aftn.	Thermom. Forn.	Thermom. Aftn.	Hygrosc. Forn.	Hygrosc. Aftn.	Wind. Forenoon. Direct.	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	30 4	30 4	9 3	10 4	2 8	2 4	W.	1	W.	1	fair	fair	0 094
2	30 4	30 5	8 9	9 7	2 6	2 5	W.	1	W.	1	fair	clou	
3	30 4	30 3	8 9	8 8	2 3	2 2	W.	2	W.	2	clou	clou	0 165
4	30 2	30 2	8 9	8 7	2 5	2 4	W.	2	W.	2	clou	clou	
5	30 1	30 0	9 7	10 4	2 2	2 1	W.	3	S. w.	2	fair	clou	0 290
6	30 0	29 9	10 8	10 6	2 8	2 2	S. w.	2	S. w.	2	clou	fair	
7	29 6	29 5	10 3	11 5	2 1	2 2	S. w.	4	S. w.	4	fair	clou	0 460
8	29 5	29 5	12 4	12 1	2 3	2 2	S. w.	2	S. w.	2	fair	clou	0 195
9	29 6	29 7	10 5	10 8	2 4	2 0	S. w.	2	S. w.	2	fair	clou	
10	29 6	29 5	9 4	10 2	2 0	2 1	S. w.	3	S. w.	4	fair	rain	
11	29 9	30 0	9 3	10 5	2 0	1 8	W.	2	W. *b* n.	1	fair	fog	
12	30 1	30 0	10 7	11 3	2 7	2 2	W.	1	W.	1	clou	driz	0 316
13	29 9	29 8	10 9	10 8	2 3	2 1	S. w.	1	W.	1	clou	clou	0 070
14	29 7	29 7	10 6	10 9	2 2	2 1	S. w.	2	S. w.	2	fair	fair	
15	29 8	29 9	8 9	9 2	2 1	1 8	W. *b* n.	2	W. *b* n.	2	fair	fair	
16	30 0	29 8	9 6	10 8	2 3	2 2	S. w.	3	S. w.	3	clou	clou	0 560
17	29 5	29 4	9 8	9 5	2 2	2 3	S. w.	2	W.	2	fair	fair	
18	29 3	29 3	8 7	9 4	2 3	2 0	N.	2	N. e.	2	ſno	fair	
19	29 4	29 5	8 5	8 6	2 2	1 8	N. e.	3	N. e.	3	clou	fair	0 496
20	29 8	29 8	7 4	9 1	1 9	1 8	W.	2	W.	2	fair	fair	0 170
21	29 9	29 9	8 6	9 2	2 2	1 8	N. w.	2	N. w.	2	fair	fair	
22	29 7	29 5	8 7	9 6	1 8	1 9	S. w.	3	S. w.	3	fair	fair	
23	28 9	28 9	9 5	9 8	2 1	1 9	S. w.	4	S. w.	3	clou	fair	
24	28 9	28 8	9 3	9 5	2 2	2 0	S. w.	3	S. w.	2	fair	fair	0 296
25	28 9	29 2	9 2	9 2	2 4	1 8	W.	2	W.	2	fair	fair	0 100
26	29 4	29 4	9 5	10 8	2 2	1 7	W.	2	S. w.	2	fair	fair	
27	29 0	28 9	10 3	10 9	2 5	1 8	S. e.	2	S. w.	2	driz	fair	
28	29 1	29 2	10 6	10 6	2 1	1 9	S.	2	S.	2	clou	fair	0 295

Total Depth 3, 507

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 7	9 0	2 1
Greateſt Height	30 5	12 4	2 8
Leaſt Height	28 8	7 4	1 7

MARCH, 1735.

Day.	Barom. For^{n}. I. D.	Barom. Aft^{n}. I. D.	Thermom. For^{n}. I. D.	Thermom. Aft^{n}. I. D.	Hygrosc. For^{n}. I. D.	Hygrosc. Aft^{n}. I. D.	Wind Forenoon Direct.	fo.	Wind Afternoon Direct.	fo	Weath. Fo.	Weath. Af	Rain In. D.
1	29 2	29 1	10 4	10 5	2 1	2 0	S. w.	2	N. w.	2	fair	clou	0 180
2	29 0	29 1	10 0	10 6	2 5	2 6	S. *b* w.	2	S. e.	2	fair	clou	
3	29 2	29 1	9 8	10 4	2 5	2 2	S.	2	W.	2	clou	clou	0 050
4	29 2	29 2	9 8	10 2	2 2	2 2	S.	1	S.	1	fair	clou	
5	29 4	29 5	11 0	11 3	2 3	2 0	S. w.	2	S. w.	2	fair	clou	
6	29 5	29 7	11 0	11 0	2 2	2 0	W. *b* n.	2	N. w.	2	fair	fair	
7	30 0	30 1	9 2	10 7	2 1	2 1	S. w.	2	E.	2	fair	fair	
8	30 1	30 1	9 8	10 6	3 0	2 8	S. e.	2	S. e.	2	fog	fog	
9	30 2	30 2	9 7	10 1	3 6	3 3	S. e.	2	S. e.	2	fog	fog	0 190
10	30 1	30 0	9 6	9 9	3 4	3 0	S. e.	2	S. e.	2	fog	fog	0 170
11	29 9	29 9	9 0	9 7	3 0	2 0	N. e.	3	N. e.	3	clou	fair	
12	29 9	29 8	9 5	10 4	0 2	1 8	E.	1	E.	1	fog	fog	
13	29 7	29 6	9 6	10 0	1 9	1 8	S. e.	1	S. e.	1	fair	fair	
14	29 4	29 3	8 6	10 5	2 0	1 8	S. e.	2	S. e.	2	fair	fair	0 290
15	29 2	29 1	9 3	9 9	1 2	2 5	S. e.	2	E.	2	fair	clou	
16	29 0		9 6		3 8		E.	3			rain		
17	29 4	29 5	8 7	9 3	2 8	2 2	N. e.	3	N. e.	3	clou	hail	
18	29 7	29 8	8 5	9 3	2 2	1 9	N. e.	2	W.	2	fair	fair	0 450
19	29 8	29 8	9 4	9 6	2 0	1 8	N. w.	2	N. w.	2	fair	fair	0 270
20	30 0	30 0	8 5	9 8	2 3	2 0	N.	2	N.	2	fair	clou	0 165
21	30 1	30 1	9 3	10 7	2 1	2 1	W.	2	W.	2	clou	fair	
22	29 7	29 6	10 4	11 5	2 5	2 7	W.	2	W.	2	rain	driz	
23	29 6	29 6	11 5	11 9	3 2	2 5	W.	2	W.	2	clou	rain	0 450
24	29 4	29 3	13 4	10 3	2 8	1 1	N. w.	2	N. w.	2	rain	rain	
25	29 3	29 2	9 8	9 9	2 7	2 2	N. e.	2	N. e.	2	clou	fair	
26	29 1	29 1	10 0	9 0	2 5	3 1	N. e.	2	N. w.	2	clou	rain	0 390
27	29 3	29 3	9 6	10 7	3 0	2 3	W.	2	N. e.	2	fair	fair	0 910
28	29 3	29 3	9 9	9 7	3 5	4 0	N. e.	2	N. e.	3	rain	rain	0 060
29	29 2	29 4	10 0	9 8	3 3	2 4	N. w.	2	N. w.	2	clou	fair	0 970
30	29 6	29 5	9 5	10 9	2 3	1 9	W.	2	S.	1	fair	clou	0 640
31	29 3	29 4	9 4	10 8	2 4	2 0	W.	1	W.	1	clou	fair	0 190

Total Depth 5, 375

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 3	9 9	2 4
Greatest Height	30 2	11 9	4 0
Least Height	29 0	8 5	1 2

APRIL, 1735.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.		Rain.
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.				
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo	Af.	In. D.
1	29 5	29 6	10 2	11 7	2 3	1 9	W.	2	N. e.	2	fair	clou	
2	29 7	29 8	11 8	13 3	2 0	1 9	S.	1	S.	1	fair	fair	0 085
3	30 0	30 0	12 3	13 0	2 3	1 7	S. e.	2	S. e.	2	fair	fair	0 070
4	30 1	30 1	10 7	10 5	2 4	2 1	S. e.	2	E.	2	clou	fair	0 190
5	30 1	30 1	10 3	9 8	2 9	2 7	E.	2	E.	2	clou	clou	
6	30 0	30 0	9 7	10 1	3 0	3 2	E.	2	E.	2	rain	driz	0 250
7	29 9	29 8	10 0	10 1	3 4	3 3	E.	2		2	fog	fog	0 060
8	29 7	29 6	10 5	10 8	3 2	2 9	E.	2	E.	1	rain	clou	
9	29 4	29 4	11 6	12 1	2 9	2 1	E.	1	S.	1	fair	clou	
10	29 4	29 3	10 8	10 2	2 9	4 1	E.	2	E.	2	clou	fog	
11	29 2	29 3	10 8	10 5	4 1	4 1	E. *b* n.	2	E. *b* n.	2	fog	fog	
12	29 4	29 5	11 9	11 5	3 9	3 1	S. w.	0	W.	1	clou	clou	0 140
13	29 7	29 8	11 4	11 7	2 7	2 4	W.	2	W.	2	fair	fair	0 050
14	29 8	29 6	12 1	12 7	2 6	2 5	S.	0	S.	2	clou	clou	
15	29 6		12 0		2 5		W. *b* ſ.	2			clou		
16	30 0	30 0	11 4	13 0	2 0	1 7	W.	2	W.	2	fair	fair	
17	29 7	29 6	12 9	12 5	2 1	2 0	S. *b* e.	1	S.	2	fair	clou	
18	29 6	29 7	11 9	11 5	2 0	1 9	S. w.	3	S. w.	2	clou	clou	
19	29 4		11 5		1 9		S. w.	3			clou		0 110
20	29 5	29 4	11 3	11 7	2 9	2 0	W.	3	W.	2	clou	clou	0 030
21	29 2	29 3	11 8	11 4	2 4	1 8	W.	4	W.	3	fair	fair	
22	29 0	29 0	11 9	11 2	2 0	2 0	W.	3	W. *b* n.	3	clou	clou	
23	29 5	29 6	11 1	12 1	1 8	1 7	W. *b* n.	2	W. *b* n.	2	fair	clou	
24	29 7	29 6	13 1	12 5	1 9	1 8	S. w.	2	S. w.	2	clou	clou	
25	29 5	29 5	12 6	13 5	1 8	1 5	S. w.	2	S. w.	1	fair	fair	0 070
26	29 6	29 5	12 8	13 4	1 7	1 5	S. w.	1	S. w.	2	fair	fair	0 290
27	29 3	29 3	11 4	10 8	2 0	2 7	N. e.	2	N. e.	2	rain	fog	0 090
28	29 2	29 3	11 7	12 0	2 0	1 9	N. w.	2	N. w.	3	clou	fair	
29	29 5	29 6	11 6	12 8	1 9	1 6	S. w.	2	S. *b* e.	1	fair	fair	
30	29 8	29 8	11 5	12 5	2 1	1 8	E. *b* ſ.	2	E.	2	fair	fair	0 195

Total Depth 1, 630

	Barom. In. D.	Ther In. D.	Hygr. In. D.
Height at a Medium	29 7	11 2	2 3
Greateſt Height	30 1	13 5	4 1
Leaſt Height	29 0	9 7	1 5

MAY, 1735.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.	Rain.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.							In. D.
1	29 9	29 7	12 7	11 7	1 9	1 9	S. w.	2	S. w.	2	clou	clou	0 020
2	29 7	29 7	12 0	11 2	1 9	1 6	W. *b* n.	2	W. *b* n.	2	fair	fair	
3	29 6	29 7	11 4	12 8	1 6	1 5	W. *b* n.	2	W. *b* n.	2	fair	fair	
4	29 9	29 9	11 7	11 6	1 5	1 5	N.	2	N. e.	1	clou	clou	0 055
5	29 9	29 9	12 0	11 7	1 6	1 5	N. e.	2	N. e.	2	fair	fair	
6	29 9	29 9	12 3	13 6	1 5	1 5	W. *b* n.	2	W.	2	fair	fair	
7	30 0	30 0	12 5	11 6	1 5	1 6	N. w.	2	N. w.	2	fair	fair	
8	30 0	30 0	12 8	12 7	1 9	1 6	S. w.	3	W.	3	clou	fair	
9	30 0	29 9	13 2	11 8	2 0	1 5	W.	4	W.	3	clou	fair	0 070
10	29 9	29 9	12 3	11 0	1 3	1 3	N. w.	3	N. w.	3	fair	fair	
11	29 7	29 5	10 9	9 5	1 3	1 9	N. w.	3	N. w.	3	fair	rain	
12	29 5	29 6	10 8	10 2	1 7	1 4	N. w.	2	N. w.	2	clou	clou	
13	29 6	29 7	11 7	10 6	1 2	1 2	N. w.	2	N. w.	2	clou	fair	0 030
14	29 6	29 5	11 6	11 5	1 4	1 3	N. w.	2	N. w.	1	fair	clou	0 190
15	29 3	29 2	10 7	11 2	1 5	1 1	S. w.	3	S. w.	3	fair	fair	
16	29 4	29 4	11 6	12 5	1 4	1 2	W. *b* f.	2	W. *b* f.	2	clou	clou	
17	29 5	29 7	12 1	12 9	1 1	1 2	W.	2	W.	2	fair	fair	
18	30 1	30 1	12 2	13 7	1 0	0 9	N. w.	2	N. w.	1	fair	fair	0 150
19	30 2	30 2	13 5	14 3	1 2	1 0	W.	2	S. w.	2	clou	clou	
20	30 0	29 8	13 7	12 9	1 4	1 2	S. w.	2	W.	2	clou	fair	
21	29 8	29 8	13 7	12 5	1 4	1 3	N. w.	2	N. w.	2	fair	clou	
22	29 6	29 7	11 9	12 6	1 6	1 8	N.	2	N.	2	rain	clou	
23	29 9	29 9	11 0	11 1	2 0	2 0	N.	2	E. *b* n.	2	clou	rain	
24	29 9	29 9	11 1	12 4	2 0	1 5	N. e.	2	N. e.	2	clou	fair	
25	29 8		12 3		1 9		N. e.	1			clou		
26	29 9	29 9	11 3	11 0	3 3	2 1	N. e.	2	N. e.	2	fog	rain	0 100
27	30 0	30 1	11 0	11 9	2 3	2 3	N. e.	2	N. e.	2	fair	fair	
28	30 2	30 1	12 2	13 6	2 3	1 9	E. *b* n.	2	E. *b* n.	1	fair	fair	
29	30 1	30 0	13 4	14 7	1 3	1 5	S. e.	1	S. e.	2	fair	fair	0 070
30	29 5	29 8	13 9	14 1	1 8	1 6	E.	2	E. *b* n.	2	clou	fair	
31	29 7	29 7	12 4	13 4	2 5	2 0	E.	2	N. e.	1	clou	fair	0 035

Total Depth 0, 720

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Height at a Medium	29 8	12 1	1 6
Greatest Height	30 2	14 7	3 3
Least Height	29 2	9 5	0 9

JUNE, 1735.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom For^n. I. D.	Thermom Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind Forenoon Direct	Wind Forenoon fo.	Wind Afternoon Direct.	Wind Afternoon fo.	Weath. Fo.	Weath. Af.
1	29 7	29 7	13 7	13 8	2 1	2 0	N. e.	2	N. e.	1	fair	fair
2	29 9	29 9	13 5	12 8	2 0	2 5	N. e.	1	N. e.	2	fog	fog
3	30 0	30 0	13 6	13 7	2 8	2 2	N. e.	2	N. e.	2	fog	fair
4	30 0	29 9	13 7	15 1	2 0	1 9	N. e.	1	S.	2	fair	fair
5	30 0	30 1	12 5	12 1	1 8	1 5	N. w.	2	N. w.	2	clou	clou
6	30 1	30 0	13 0	14 9	1 3	1 3	N. w.	2	E.	2	fair	fair
7	29 9	29 8	13 2	14 5	1 8	1 5	E.	1	W.	1	fair	fair
8	29 8	29 7	14 8	13 8	1 5	1 4	W.	1	S. w.	2	fair	clou
9	29 7	29 6	14 0	13 6	1 5	1 4	S. w.	2	W. *b* f.	2	clou	fair
10	29 6	29 7	13 5	13 2	1 4	1 5	W.	1	N. w.	1	fair	clou
11	29 7	29 7	13 6	14 7	1 6	1 3	W.	1	W.	1	clou	fair
12	29 8	29 8	13 7	13 7	1 6	1 4	W.	0	W.	1	clou	clou
13	29 6	29 8	14 0	13 9	1 8	1 6	W.	1	W.	2	fair	clou
14	29 8	29 8	13 7	13 3	1 6	1 4	W.	1	W.	0	clou	fair
15	29 7	29 6	15 5	14 7	1 4	1 3	S. *b* w.	2	S. *b* w.	2	fair	clou
16	29 4	29 4	11 8	12 6	1 5	1 5	W.	2	W.	2	clou	fair
17	29 4	29 4	14 2	13 3	1 4	1 5	S.	2	S. e.	2	clou	fair
18	29 5	29 6	14 3	13 4	1 6	1 7	E.	2	E.	2	clou	fair
19	29 6	29 6	12 1	13 6	1 8	1 6	E. *b* n.	2	E. *b* n.	2	fog	fair
20	29 7	29 7	13 1	13 2	2 4	2 0	N. e.	2	N. e.	2	fog	fog
21	29 8	29 8	13 8	13 2	2 4	2 1	N. e.	2	E. *b* n.	2	fair	clou
22	29 7	29 7	14 2	14 4	2 1	1 7	N. w.	2	N. e.	2	clou	clou
23	29 8	29 9	12 2	13 8	1 8	1 5	N. e.	2	N. e.	1	fair	fair
24	29 8	29 7	14 0	13 8	1 6	1 5	W.	2	W.	1	clou	fair
25	29 5	29 5	13 2	12 4	1 5	1 6	W.	2	W.	2	clou	fair
26	29 4	29 5	13 2	13 4	1 7	1 4	W.	1	W.	3	clou	clou
27	29 6	29 6	13 6	13 6	1 5	1 5	W.	2	W.	2	fair	fair
28	29 6	29 5	14 5	13 5	1 5	1 9	W.	2	S. e.	1	clou	rain
29	29 4	29 4	13 2	12 5	2 2	1 5	W.	2	W.	2	clou	fair
30	29 6	29 7	13 6	13 7	1 5	1 4	N. w.	2	W.	2	clou	fair

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 1	15 5	2 8
Least Height	29 4	11 8	1 3
Height at a Medium	29 7	13 5	1 6

JULY, 1735.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.
1	29 6	29 5	14 4	14 3	1 7	1 5	W.	1	W. *b* n.	2	fog	fair
2	29 5	29 4	14 6	12 5	1 5	2 8	S. *b* e.	1	S. e.	2	clou	fog
3	29 5	29 6	13 6	14 7	2 7	1 5	S. w.	1	W.	2	clou	fair
4	29 7	29 8	12 1	12 4	3 0	2 2	N. e.	2	N. e.	2	clou	clou
5	29 9	29 9	13 1	13 0	2 3	2 5	N. e.	1	N. e.	1	clou	fog
6	30 0	29 9	13 4	12 3	2 8	2 6	N. e.	2	N. e.	2	fog	fog
7	29 7	29 7	14 3	15 6	3 0	3 0	N. e.	2	N. e.	1	clou	clou
8	29 6	29 6	13 0	13 0	2 4	2 7	N. *b* w.	2	N. *b* e.	1	rain	clou
9	29 7	29 7	13 8	14 2	1 4	2 1	N. *b* w.	1	N.	2	fair	clou
10	29 6	29 5	13 0	13 5	2 1	2 0	N. e.	1	W.	2	fair	clou
11	29 6	29 5	13 1	13 4	2 0	1 9	W.	1	W.	2	fair	fair
12	29 3	29 2	13 7	13 6	1 6	1 6	S. e.	2	S. e.	2	clou	clou
13	29 1	29 2	13 7	13 4	2 0	1 8	W.	2	N. w.	2	clou	clou
14	29 4	29 5	13 5	13 0	1 8	1 6	W.	2	W.	2	fair	fair
15	29 4	29 4	13 3	14 1	1 8	1 7	N.	2	S. *b* e.	2	fair	clou
16	29 2	29 2	12 7	13 3	3 0	2 8	N. e.	2	E.	2	rain	rain
17	29 4	29 6	13 7	13 4	2 3	2 0	W.	2	N. w.	1	clou	clou
18	29 8	29 9	12 7	13 3	2 0	1 4	N. w.	1	N. w.	1	fair	fair
19	29 9	29 8	14 4	14 0	1 6	1 5	S. *b* w.	1	S. *b* w.	2	fair	clou
20	29 6	29 7	14 3	14 6	1 8	1 5	W.	2	N. w.	2	clou	fair
21	29 9	29 9	14 2	14 4	1 6	1 5	E.	2	E.	2	fair	fair
22	29 7	29 6	14 2	13 7	1 5	1 5	S. e.	1	E.	2	fair	rain
23	29 5	29 4	14 1	14 4	2 4	2 0	S. *b* e.	0	S. *b* e.	0	clou	clou
24	29 4	29 4	13 3	13 5	1 8	1 6	W.	2	W.	2	clou	clou
25	29 4	29 4	14 5	14 3	1 6	1 5	S. w.	2	S. w.	2	fair	fair
26	29 5	29 7	13 8	14 4	1 7	1 6	W.	2	W.	2	clou	fair
27	29 8	29 8	13 4	14 0	1 8	1 5	S. w.	2	S. w.	2	clou	fair
28	29 9	29 9	15 6	15 2	1 6	1 6	S. w.	2	S. w.	2	fair	fair
29	30 0	30 0	15 5	15 5	1 6	1 6	S. w.	1	N. e.	1	fair	fair
30	29 9	29 0	15 6	16 0	1 7	1 4	S. e.	2	S. e.	2	fair	fair
31	29 9	29 9	15 2	15 6	1 8	1 8	S. e.	2	S. e.	2	clou	clou

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 0	16 0	3 0
Least Height	29 1	12 1	1 4
Height at a Medium	29 7	14 2	1 9

AUGUST, 1735.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.	
	For^{n}.	Aft^{n}.	For^{n}.	Aft^{n}.	For^{n}.	Aft^{n}.	Forenoon.		Afternoon.			
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.
1	29 9	29 9	15 0	15 6	1 9	1 5	S. e.	1	S. e.	2	clou	clou
2	30 0	30 0	15 7	15 2	1 4	1 7	S. e.	2	W.	1	fair	clou
3	30 1	30 1	14 0	14 7	1 5	1 5	S. w.	1	S. e.	2	fair	fair
4	30 2	30 3	14 0	14 3	1 5	1 6	S. e.	2	E.	2	clou	clou
5	30 3	30 3	13 2	13 2	1 9	1 6	N. e.	2	N. e.	2	clou	fair
6	30 3	30 3	13 0	13 0	1 7	1 7	N. e.	2	N. e.	1	clou	fair
7	30 3	30 3	14 0	14 2	1 6	1 5	N. e.	2	E.	2	fair	fair
8	30 3	30 2	13 7	13 7	1 6	1 5	E.	2	E.	1	clou	clou
9	30 3	30 3	12 9	14 6	1 5	1 4	E.	1	E.	1	clou	fair
10	30 3	30 3	14 7	15 3	1 7	1 5	E.	1	E.	1	fair	fair
11	30 3	30 3	16 1	17 0	1 6	1 6	E.	1	S. w.	1	fair	clou
12	30 2	30 2	16 9	16 6	1 7	1 4	S. w.	2	S. w.	2	clou	fair
13	30 0	29 8	15 6	15 3	1 7	1 5	S. w.	2	S. w.	2	clou	clou
14	29 6	29 6	13 5	13 4	1 5	1 7	W.	2	W.	2	rain	clou
15	29 7	29 7	13 2	13 7	1 7	1 4	W.	2	W.	2	fair	fair
16	29 8	29 8	13 7	13 4	1 6	1 4	W.	2	W.	2	fair	clou
17	29 8	29 6	13 6	14 3	1 7	2 0	S. w.	2	S. w.	2	clou	rain
18	29 5	29 4	14 9	15 3	2 6	2 1	S. w.	2	S. w.	2	clou	clou
19	29 6	29 6	14 0	13 4	2 0	1 6	S. w.	2	W.	2	fair	fair
20	29 6	29 6	14 0	13 5	1 7	1 6	W.	2	W.	2	clou	fair
21	29 4	29 4	13 6	13 7	1 9	1 5	W.	2	S. w.	2	fair	clou
22	29 4	29 3	13 3	13 3	1 7	1 6	W.	2	W.	2	fair	rain
23	29 5	29 6	11 5	12 3	3 0	1 9	S. w.	2	S. w.	2	fair	fair
24	29 5	29 5	11 8	12 4	2 3	1 6	W.	1	W.	2	clou	fair
25	29 4	29 2	12 2	13 4	2 1	1 9	S. *b* w.	2	S. *b* w.	2	clou	clou
26	29 2	29 4	13 3	13 4	1 7	1 7	S. *b* w.	2	N. e.	2	fair	clou
27	29 8	29 9	11 5	13 4	1 8	1 6	W.	1	W.	1	fair	fair
28	29 9	29 6	13 3	14 6	1 9	1 9	S. w.	1	S. w.	2	clou	rain
29	29 9	29 9	12 5	12 8	1 7	1 5	W.	2	W.	2	fair	fair
30	29 6	29 8	12 6	12 6	2 1	1 5	W.	2	W. *b* n.	2	fair	clou
31	29 8	29 8	12 4	12 5	1 7	1 8	W.	2	W.	2	clou	clou

	Barom.	Ther.	Hygr.
	In. D.	In. D.	In. D.
Greatest Height	30 3	17 0	3 0
Least Height	29 2	11 5	1 4
Height at a Medium	29 8	13 8	1 9

SEPTEMBER, 1735.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.	
	For^n^.	Aft^n^.	For^n^.	Aft^n^.	For^n^.	Aft^n^.	Forenoon.		Afternoon.			
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.
1	28 9	29 2	13 3	12 0	1 9	1 9	W.	2	W.	2	fair	fair
2	29 4	28 9	12 7	11 8	1 8	1 2	W.	3	W.	3	fair	rain
3	28 9	28 9	11 8	12 3	1 7	1 6	W.	3	S. w.	3	fair	fair
4	29 3	29 5	12 7	13 0	1 5	1 5	N. w.	3	N. w.	2	fair	fair
5	29 6	29 7	12 9	12 8	2 3	2 1	W.	1	W.	1	clou	fair
6	29 8	29 7	12 8	12 7	1 9	1 7	S. e.	2	W.	1	clou	fair
7	29 8	29 9	13 5	12 7	2 4	1 6	W.	2	W.	2	fair	fair
8	29 9	29 8	12 5	13 1	1 9	1 8	S. w.	2	S. w.	1	clou	clou
9	29 6	29 7	11 3	11 3	2 3	1 7	N. e.	2	N.	2	rain	fair
10	29 8	30 0	11 6	11 2	1 6	1 5	N. w.	2	N. w.	2	fair	fair
11	30 0	30 0	11 6	12 5	1 6	1 7	N. w.	1	W. *b* f.	1	clou	clou
12	30 0	30 0	12 3	13 2	1 8	1 5	S. w.	1	S. w.	1	clou	clou
13	30 0	29 9	12 3	12 5	1 8	1 6	W.	1	W.	1	fair	clou
14	29 8	29 8	11 7	12 4	1 9	1 5	S. w.	2	N. w.	2	fair	fair
15	29 8	29 8	12 1	12 8	1 8	1 9	W.	2	W.	2	clou	clou
16	29 8	29 9	11 1	12 1	2 0	1 7	W.	1	W.	1	fair	fair
17	29 9	29 9	12 8	14 4	1 8	1 7	S.	2	S. w.	2	clou	fair
18	30 0	30 0	13 8	14 1	1 9	1 7	S. w.	3	S. w.	2	fair	clou
19	30 0	29 9	12 5	11 3	1 9	2 1	W.	1	W.	1	clou	clou
20	29 7	29 6	11 8	12 0	2 9	2 8	S. w.	1	S. w.	1	fair	clou
21	29 4	29 2	11 9	11 9	2 0	1 8	S. w.	1	S. w.	1	fair	fair
22	28 7	28 8	10 7	11 9	1 9	1 9	W.	3	W.	2	rain	clou
23	29 4	29 5	11 2	11 8	1 7	1 7	N. w.	2	W.	1	fair	rain
24	29 3	29 3	11 5	12 2	2 2	1 9	N. w.	1	N. w.	1	fair	clou
25	29 7	29 9	10 7	11 1	2 0	1 6	N.	2	N.	2	fair	fair
26	30 0	29 9	10 1	11 0	1 7	1 8	W. *b* n.	2	W.	2	clou	clou
27	29 8	29 8	12 0	11 8	2 6	1 9	N. e.		E. *b* n.	1	clou	clou
28	29 7	29 7	11 6	12 2	1 9	1 7	E.	1	E.	1	fair	fair
29	29 7	29 7	11 6	10 0	1 8	1 8	W.	2	S. w.	2	clou	clou
30	29 3	29 3	9 9	10 6	2 2	2 0	S. w.	3	S. w.	1	rain	clou

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height———	30 0	14 4	2 9
Least Height ———	28 7	9 9	1 2
Height at a Medium ———	29 6	12 0	1 8

OCTOBER, 1735.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11	29 6	29 7	11 3	11 1	2 6	2 1	E.	2	E.	2	clou	clou
12	29 8	29 9	10 4	10 8	2 4	2 1	S. e.	1	S. e.	2	fair	clou
13	30 0	30 0	10 2	11 2	2 2	2 2	E.	2	E.	2	clou	clou
14	30 1	30 1	10 8	10 7	2 3	1 9	S. e.	2	S. e.	2	clou	clou
15	29 8	29 7	10 4	10 7	2 3	2 3	S. e.	2	S. e.	2	rain	clou
16	29 8	29 8	11 6	11 3	2 4	1 7	S. e.	1	S. w.	2	clou	clou
17	29 9	30 1	12 0	12 3	2 4	2 4	S. w.	2	S. w.	2	clou	clou
18	30 2	30 3	11 2	11 5	2 6	2 4	S. e.	1	S. e.	2	fair	clou
19	30 3	30 3	11 5	11 2	2 5	2 3	E. *b* f.	0	E. *b* f.	1	clou	clou
20	30 3	30 2	9 8	10 6	2 3	2 2	E. *b* f.	1	E. *b* f.	1	fair	fair
21	30 0	29 9	10 5	11 0	2 3	2 2	S. e.	1	S. e.	1	clou	clou
22	29 8	29 8	11 6	12 6	2 6	2 5	S.	1	S. w.	1	fair	clou
23	30 0	30 0	12 6	12 2	2 7	2 6	N.	2	N.	2	clou	clou
24	30 1	30 1	11 8	12 0	3 1	2 7	E.	2	E.	1	clou	clou
25	29 9	29 9	11 9	12 0	2 8	2 0	E.	0	E.	0	fog	fog
26	29 4	29 3	12 6	12 7	2 8	2 7	S. w.	2	W.	2	clou	clou
27	29 5	29 5	10 0	10 2	2 2	1 8	W.	2	W. *b* n.	2	fair	fair
28	29 6	29 6	8 5	9 4	2 0	1 6	W. *b* n.	2	W. *b* n.	2	fair	fair
29	29 8	29 8	8 1	9 0	1 8	1 5	N. w.	2	N. w.	2	fair	fair
30	30 1	30 1	8 5	9 5	1 8	1 7	W.	1	W.	1	fair	clou
31	30 1	29 9	9 6	10 0	2 0	2 0	W.	1	W.	2	clou	clou

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 3	12 7	3 1
Least Height	29 3	8 1	1 5
Height at a Medium	29 9	10 8	2 2

NOVEMBER, 1735.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.	
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^n.	Forenoon.		Afternoon.			
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo	Fo.	Af.
1	29 7	29 7	10 3	10 4	2 6	2 4	N. w.	2	N. w.	0	fair	clou
2	30 0	30 0	9 7	10 2	2 4	2 2	S. e.	0	S. e.	0	clou	clou
3	30 0	30 0	10 0	10 2	2 0	2 0	S. w.	0	S. w.	0	clou	clou
4	29 9	29 9	10 1	9 7	2 1	2 1	S. e.	0	S. e.	0	clou	fair
5	29 8	29 7	10 2	11 3	2 0	2 3	S. e.	0	S.	2	fair	clou
6	30 0	30 0	10 0	10 5	2 5	2 5	W.	0	W.	0	fair	fair
7	29 8	29 8	9 6	10 3	2 3	2 2	S. e.	3	S. e.	2	clou	clou
8	29 7	29 6	10 5	10 6	2 4	2 3	S. *b* e.	2	S. *b* e.	2	clou	clou
9	29 4	29 3	11 6	11 5	2 2	2 2	S. *b* e.	2	S. *b* e.	2	clou	clou
10	29 5	29 6	10 6	10 9	2 1	2 1	S.	1	S. w.	2	fair	fair
11	29 8	30 0	9 6	10 4	2 4	2 5	S. *b* e.	2	S. *b* e.	2	clou	clou
12	29 8	29 7	10 5	11 7	2 1	2 1	S.	3	S.	3	clou	clou
13	29 9	29 9	10 3	10 5	2 2	2 2	S.	1	W.	2	fair	fair
14	29 5	29 7	12 1	10 6	2 3	2 2	W.	2	S. w.	2	clou	clou
15	29 6	29 3	11 0	12 0	2 1	2 2	S.	3	S.	4	clou	clou
16	29 3	29 3	11 5	11 6	2 3	2 1	S. w.	2	S. w.	2	fair	fair
17	29 4	29 5	10 4	11 0	2 4	2 2	W.	2	W.	2	fair	clou
18	29 2	29 2	10 4	11 3	3 4	2 9	W.	1	S.	2	clou	clou
19	29 3	29 4	11 8	11 7	3 0	3 0	S.	0	S. e.	1	clou	fog
20	29 6	29 6	10 7	11 6	2 9	2 7	S. *b* w.	1	S. w.	2	clou	clou
21	29 5	29 4	11 6	11 1	2 7	2 1	S. e.	2	S. *b* e.	2	clou	clou
22	29 5	29 5	10 7	10 8	2 6	2 6	S.	2	S.	2	fair	fair
23	29 5	29 2	9 5	10 5	2 6	2 3	S. e.	2	S. e.	2	fair	clou
24	29 3	29 1	10 1	10 4	2 5	2 6	S.	3	W.	2	clou	clou
25	29 0	29 1	9 1	9 4	2 6	2 6	N. w.	0	N. w.	0	clou	clou
26	29 3	29 2	7 7	8 1	2 7	2 8	W. *b* n.	0	N. w.	0	fair	fair
27	28 8	28 8	10 0	10 9	3 0	3 3	S. e.	0	S. e.	1	fog	fair
28	29 0	29 2	10 7	10 5	3 9	4 0	N. e.	2	N. e.	1	rain	rain
29	29 7	29 7	10 2	9 9	4 1	4 0	N.	0	N.	0	clou	clou
30	29 7	29 7	10 0	10 0	3 6	3 3	W.	1	W.	1	fair	fair

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 0	12 1	4 1
Least Height	28 8	7 7	2 0
Height at a Medium	29 5	10 5	2 5

DECEMBER, 1735.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.	
	Forn.	Aftn.	Forn.	Aftn.	Forn.	Aftn.	Forenoon.		Afternoon.			
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D	Direct.	fo.	Direct.	fo.	Fo	Af.
1	29 6	29 5	10 0	10 2	3 3	3 5	S. e.	0	S. e.	0	rain	clou
2	29 6	29 5	10 3	10 8	3 6	3 6	S. e.	0	S. e.	0	clou	clou
3	29 3	29 3	11 5	11 4	3 2	3 0	S. w.	2	S. w.	2	vari	clou
4	29 1	29 0	11 2	11 5	3 1	3 0	S.	2	S.	2	clou	clou
5	29 0	29 1	9 4	9 5	3 0	2 6	N. *b* w.	2	N. *b* w.	2	clou	clou
6	29 7	29 8	8 0	7 9	2 3	2 3	N. *b* w.	2	N. w.	2	fair	fair
7	30 0	29 9	7 7	8 3	2 3	2 4	N. w.	2	N. w.	2	clou	clou
8	29 7	29 6	8 9	9 0	2 0	3 0	N. e.	2	N. e.	1	rain	rain
9	29 6	29 7	9 9	9 8	3 8	3 6	E. *b* n.	2	N. e.	2	clou	clou
10	30 1	30 1	8 7	8 8	2 7	2 7	N. e.	2	N. e.	2	clou	fair
11	30 2	30 2	8 1	8 2	2 7	2 6	N. e.	1	N. e.	1	fair	fair
12	30 2	30 2	8 4	8 3	2 5	2 2	W.	2	W.	2	clou	clou
13	30 1	30 1	8 6	8 8	2 6	2 5	W.	1	W.	1	clou	clou
14	30 1	30 1	9 0	9 4	2 7	2 9	S. e.	0	S. e.	0	clou	clou
15	30 1	30 0	8 5	8 9	2 8	2 7	W.	1	W.	2	clou	clou
16	29 7	29 5	10 5	10 9	2 9	3 0	W.	2	W.	2	clou	clou
17	29 6	29 6	10 0	10 5	2 9	3 0	W.	2	W.	2	fair	haz
18	29 7	29 8	9 5	10 0	2 7	3 0	W.	0	W.	0	clou	fair
19	29 8	29 8	10 4	10 5	3 1	3 2	W.	2	W.	2	clou	clou
20	29 8	29 8	10 3	10 3	3 0	2 7	N. w.	2	N. w.	2	fair	clou
21	30 1	30 1	9 5	9 4	2 6	2 6	N. w.	0	W.	0	clou	clou
22	30 1	30 0	9 8	10 0	2 6	2 5	S.	2	S.	2	clou	clou
23	30 0	30 0	8 2	8 1	2 5	2 4	S.	2	S.	1	fair	fair
24	29 7	29 7	7 5	9 2	2 2	2 3	S.	2	S.	3	fair	clou
25	29 4	29 5	10 7	11 0	2 6	2 7	S.	2	S.	2	clou	haz
26	29 6	29 6	10 5	11 4	3 0	3 0	S. *b* e.	0	S. *b* e.	1	haz	haz
27	29 5	29 4	10 2	10 7	2 8	2 7	S. *b* e.	0	S. *b* e.	0	fair	fair
28	29 0	29 1	11 3	10 7	2 5	2 3	S.	3	S.	2	fair	driz
29	29 3	29 4	10 0	10 3	2 4	2 4	S.	3	S.	3	fair	fair
30	29 6	29 6	9 4	9 8	2 5	2 4	S.	2	S.	2	fair	fair
31	29 6	29 5	8 7	10 0	2 5	2 5	S.	2	S.	2	fair	clou

	Barom. In. D.	Ther In. D.	Hygr. In. D.
Greatest Height	30 2	11 5	3 8
Least Height	29 0	7 5	2 2
Height at a Medium	29 7	9 6	2 7

JANUARY, 1736.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygrosc. For^n.	Hygrosc. Aft^n.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.						
1	29 5	29 5	10 2	10 0	2 5	2 6	S. e.	3	S. e.	2	clou	haz
2	29 5	29 5	10 0	10 3	2 8	2 7	S. e.	2	S. e.	2	fair	clou
3	29 4	29 1	9 8	10 3	2 6	2 5	S. *b* e.	2	S. *b* e.	3	clou	clou
4	29 1	29 1	11 5	11 7	2 7	2 6	S.	2	S.	3	haz	clou
5	29 6	29 6	9 4	10 4	2 4	2 4	S. *b* w.	2	S. *b* w.	3	fair	rain
6	29 6	29 6	10 1	10 7	2 6	2 3	S. w.	3	S. w.	2	clou	clou
7	29 7	29 7	10 8	10 9	2 3	2 3	W.	2	S. w.	1	fair	clou
8	29 7	29 6	10 2	9 9	2 5	2 5	S. *b* e.	2	S. *b* e.	2	clou	clou
9	29 5	29 5	10 0	10 5	2 4	2 5	S. w.	2	S. w.	1	clou	rain
10	29 3	29 1	9 4	10 8	2 4	2 3	S.	2	S. w.	2	fair	fair
11	29 0	29 0	9 0	9 0	2 4	2 3	S. w.	2	S. w.	2	fair	fair
12	29 3	29 3	8 6	9 3	2 4	2 4	S.	2	S.	2	fair	fair
13	29 2	29 1	9 7	10 3	2 5	2 4	S. *b* e.	2	S. *b* e.	2	clou	clou
14	28 9	28 9	8 9	9 0	2 5	2 5	S. w.	2	S. w.	2	clou	fair
15	29 0	29 0	8 4	8 5	2 6	2 6	W.	2	W.	2	fair	fair
16	29 1	29 1	7 4	8 1	2 9	3 0	W.	2	W.	2	fair	clou
17	29 2	29 3	7 4	8 0	2 9	2 9	S.	0	S.	0	fair	fair
18	29 4	29 3	8 4	9 0	3 0	2 9	S.	0	S.	0	clou	clou
19	29 2	29 2	9 3	9 2	2 9	2 4	S. *b* w.	1	S. *b* w.	3	fair	clou
20	29 3	29 3	8 9	9 3	1 4	2 4	S. *b* w.	2	S. w.	0	fair	clou
21	29 3	29 3	7 6	8 9	2 5	2 4	W.	2	W.	1	fair	fair
22	29 4	29 6	8 8	8 3	2 7	2 3	N.	2	N.	2	haz	clou
23	29 6	29 6	7 3	7 9	2 4	2 3	N.	2	N. e.	2	fair	fair
24	29 4	29 2	8 5	8 7	2 3	2 5	S. *b* e.	2	S. *b* e.	2	clou	clou
25	28 9	28 9	8 7	9 0	2 8	2 5	S. w.	2	S. w.	2	fair	fair
26	28 9	28 9	8 4	8 8	2 7	2 5	W.	1	W.	1	ſno	fair
27	29 1	29 2	9 2	9 5	2 4	2 6	S. *b* e.	0	S. *b* e.	0	clou	fair
28	29 4	29 4	9 5	9 5	2 6	2 5	S. e.	2	S. e.	2	clou	clou
29	29 6	29 6	8 8	8 6	2 7	2 9	W.	2	W.	2	clou	clou
30	29 6	29 6	7 8	9 0	3 0	2 9	S. e.	1	S. e.	1	fog	fair
31	29 4	29 4	8 6	8 8	2 9	2 9	S. e.	0	S. e.	0	fog	fog

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greateſt Height	29 7	11 7	3 0
Leaſt Height	28 9	7 3	1 4
Height at a Medium	29 3	9 2	2 5

FEBRUARY, 1736.

Day.	Barom. For^n.	Barom. Aft^n.	Thermom. For^n.	Thermom. Aft^n.	Hygroſc. For^n	Hygroſc. Aft^n.	Wind. Forenoon. Direct	fo.	Wind. Afternoon. Direct.	fo.	Weath. Fo.	Weath. Af.
	I. D.	I. D.	I. D	I. D.	I. D.	I. D.						
1	29 5	29 4	8 7	9 1	2 8	2 6	S.	0	S.	2	fair	clou
2	28 5	28 5	9 7	9 8	2 7	2 5	W. *b* ſ.	2	W. *b* ſ.	1	clou	clou
3	29 1	29 2	8 6	9 2	3 0	2 7	W.	2	W.	0	fair	fair
4	29 1	29 2	8 7	9 5	2 9	2 8	N. e.	2	N. e.	2	clou	clou
5	29 4	29 3	9 2	9 0	3 1	3 0	N. e.	2	E.	2	clou	clou
6	29 4	29 4	8 8	9 1	2 8	2 7	S. e.	2	S. e.	2	clou	clou
7	29 5	29 4	8 6	8 6	2 7	2 4	S. e.	2	S. e.	2	fair	fair
8	29 4	29 3	7 8	7 9	2 4	2 3	S. e.	3	S. e.	3	clou	ſno
9	29 3	29 3	8 0	8 0	2 5	2 4	S. e.	2	S. e.	2	clou	clou
10	29 4	29 5	8 0	8 0	2 4	2 0	S. e.	2	S. e.	2	clou	clou
11	29 7	29 8	7 7	7 2	2 0	2 0	N. e.	2	N. w.	2	fair	fair
12	30 0	30 0	7 9	8 0	2 0	2 0	N.	2	N.	2	fair	fair
13	29 9	29 8	8 6	9 1	2 4	2 3	W.	0	W.	0	clou	clou
14	29 7	29 7	9 6	9 4	2 5	2 3	N. e.	2	N. e.	2	fair	fair
15	29 4	29 3	9 5	10 1	2 6	2 1	N. w.	2	W. *b* n.	2	clou	fair
16	29 4	29 5	6 8	6 3	2 0	2 0	N. w.	3	N. w.	3	fair	fair
17	29 4	29 4	8 2	8 7	2 1	2 1	N. w.	2	N. w.	2	clou	clou
18	29 6	29 6	8 2	8 6	2 4	2 3	N. w.	0	N. w.	1	ſno	fair
19	29 5	29 6	8 1	8 4	2 2	2 1	E.	2	E.	2	fair	fair
20	29 5	29 4	6 9	7 7	2 4	2 0	E.	1	E.	1	fair	fair
21	29 2	29 2	8 4	8 4	2 0	1 8	E. *b* ſ.	2	E.	3	fair	clou
22	29 1	29 0	8 3	7 8	2 1	2 9	N. e.	3	N. e.	3	ſno	ſno
23	29 2	29 2	7 6	7 9	3 2	2 7	N.	2	N.	2	clou	fair
24	29 5	29 5	7 1	8 3	2 7	2 4	N. *b* w.	1	N. *b* w.	1	fair	fair
25	29 6	29 6	7 9	8 9	2 6	2 3	W.	1	N. w.	2	clou	fair
26	29 8	29 7	8 7	8 7	2 3	2 3	N. w.	0	S. e.	1	fair	clou
27	29 6	29 6	9 2	10 3	2 6	2 6	S. w.	0	S. w.	2	clou	clou
28	29 7	29 7	10 0	9 6	2 7	2 4	W.	2	W.	2	clou	clou
29	30 1	30 1	8 6	9 5	2 3	2 0	N. w.	2	N. w.	2	fair	clou

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greateſt Height	30 1	10 3	3 2
Leaſt Height	29 0	6 3	1 8
Height at a Medium	29 4	8 5	2 4

MARCH, 1736.

Day.	Barom. For$^{n.}$ I. D.	Barom. Aft$^{n.}$ I. D.	Thermom. For$^{n.}$ I. D.	Thermom. Aft$^{n.}$ I. D.	Hygrosc. For$^{n.}$ I. D.	Hygrosc. Aft$^{n.}$ I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.
1	30 2	30 2	9 3	9 5	2 2	2 2	N. e.	3	N. e.	3	clou	clou
2	30 2	30 2	9 2	9 4	2 1	2 5	N. e.	2	N. e.	2	clou	clou
3	30 1	30 1	8 9	8 8	2 3	2 0	E.	2	N. e.	2	fair	fair
4	29 9	29 6	9 5	10 6	2 1	2 2	N. w.	2	N. w.	2	clou	clou
5	29 5	29 2	10 0	10 4	2 1	2 3	W.	2	S. w.	1	fair	rain
6	29 0	28 9	9 2	9 2	2 2	2 0	S. w.	2	S. w.	2	fair	fair
7	28 9	29 1	9 1	9 0	2 2	1 7	N. w.	2	N. w.	2	fair	fair
8	29 4	29 4	8 9	8 5	2 0	2 0	W.	2	W.	2	fair	fair
9	29 4	29 5	9 3	10 1	2 0	1 6	W. *b* n.	2	W. *b* n.	2	fair	fair
10	29 7	29 7	9 6	11 1	2 1	1 9	S. w.	2	S. w.	2	fair	fair
11	29 6	29 6	11 4	11 8	2 0	1 9	S. *b* w.	4	S. *b* w.	3	fair	fair
12	29 9	30 0	12 5	12 2	2 1	1 9	S. w.	1	W.	2	clou	fair
13	30 0	30 0	11 5	11 7	1 9	1 7	S.	2	W.	2	fair	fair
14	30 0	30 0	11 6	12 0	1 9	1 8	N. w.	1	N. w.	1	clou	fair
15	30 0	30 1	10 7	9 8	2 2	3 0	E.	1	E.	2	fog	fog
16	30 1	30 0	10 4	11 1	3 2	2 4	E.	1	S. e.	2	fog	fair
17	30 0	30 0	10 5	11 3	2 5	1 9	S. e.	2	S. e.	2	clou	fair
18	30 0	29 9	9 1	10 6	2 1	1 8	S. e.	2	S. e.	2	fair	fair
19	29 6	29 5	9 5	10 1	2 0	1 9	S. e.	3	S. e.	2	fair	clou
20	29 4	29 4	9 7	9 8	2 5	2 6	E.	2	E.	2	rain	rain
21	29 4	29 4	10 0	10 7	2 5	2 4	S. e.	2	S. e.	2	clou	clou
22	29 3	29 2	10 5	11 3	2 6	1 9	S. e.	2	S. e.	2	rain	clou
23	29 1	29 1	10 1	9 8	2 9	3 2	E.	2	E.	2	fog	fog
24	29 1	29 1	10 3	10 9	3 4	3 0	E.	2	E.	1	fog	fair
25	29 3	29 4	11 5	12 2	3 0	2 0	N. e.	0	W.	1	clou	fair
26	29 4	29 4	10 9	12 0	2 2	2 3	S. w.	0	S. *b* w.	0	clou	clou
27	29 6	29 5	10 6	11 4	2 5	2 5	S. *b* e.	1	S. e.	1	fog	clou
28	29 4	29 5	11 9	14 7	2 7	2 0	S. e.	2	S. e.	2	rain	fair
29	29 6	29 5	10 6	11 1	3 1	3 1	E.	2	E.	2	fog	rain
30	29 6	29 7	11 7	12 3	3 0	2 1	S. w.	1	S. w.	0	clou	clou
31	29 8	29 9	11 6	11 3	2 5	1 9	W.	2	W.	2	fair	fair

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 2	14 7	3 4
Least Height	28 9	8 5	1 6
Height at a Medium	29 6	10 5	2 2

APRIL, 1736.

Day.	Barom. For^n. I. D.	Barom. Aft^n. I. D.	Thermom. For^n. I. D.	Thermom. Aft^n. I. D.	Hygrosc. For^n. I. D.	Hygrosc. Aft^n. I. D.	Wind. Forenoon. Direct.	Wind. Forenoon. fo.	Wind. Afternoon. Direct.	Wind. Afternoon. fo.	Weath. Fo.	Weath. Af.
1	29 8	29 9	11 4	11 6	2 6	2 7	N. e.	0	N. e.	0	fog	fog
2	29 9	29 9	11 0	11 3	3 1	2 9	N. e.	1	N. e.	1	fog	clou
3	30 2	30 2	12 2	13 0	3 0	2 5	N. e.	0	N. e.	0	fair	fair
4	30 3	30 3	12 9	13 4	2 3	1 9	S. w.	0	S. w.	2	fair	fair
5	30 0	30 1	12 3	11 6	2 0	1 8	S. w.	2	N. e.	2	fair	fair
6	30 2	30 2	11 3	12 2	1 7	1 6	N. w.	2	N. w.	2	fair	fair
7	30 2	30 0	10 8	10 2	1 8	1 3	W.	2	W. *b* n.	2	fair	fair
8	29 9	29 7	11 9	11 5	2 1	1 9	W. *b* n.	2	W. *b* n.	2	fair	fair
9	29 6	29 9	9 1	9 2	2 5	2 3	N. w.	2	N. w.	3	ſno	clou
10	30 0	30 0	9 1	9 7	1 6	1 5	N. w.	2	W. *b* n.	2	clou	clou
11	29 7	29 8	10 8	10 4	2 0	1 8	W.	2	N. e.	2	fair	rain
12	29 7	29 7	9 5	8 7	2 9	2 7	N. e.	2	N. e.	2	clou	clou
13	30 0	30 0	8 5	9 8	2 2	1 7	N. w.	2	N. w.	2	fair	fair
14	29 6	29 2	10 0	11 2	1 8	1 9	S.	4	S.	3	clou	clou
15	28 9	29 0	10 5	10 5	2 5	2 0	W. *b* n.	2	W. *b* n.	2	rain	clou
16	29 3	29 4	10 4	10 3	2 9	2 2	N. *b* w.	2	N. *b* w.	2	clou	clou
17	29 5	29 6	10 0	10 5	2 0	1 8	N. w.	2	N. w.	2	clou	fair
18	29 6	29 6	10 4	10 3	2 0	1 6	W.	2	N. w.	2	fair	clou
19	29 6	29 6	10 2	10 0	2 0	1 8	W. *b* n.	2	W. *b* n.	2	fair	fair
20	29 7	29 7	11 5	12 2	1 9	1 5	W.	2	W.	0	clou	fair
21	29 8	29 8	11 5	12 2	1 8	1 7	S.	0	S. e.	2	fair	fair
22	29 9	29 8	11 8	13 0	1 8	1 8	S. e.	0	S.	2	rain	clou
23	29 8	30 0	13 4	13 6	2 0	2 0	S.	1	S.	1	rain	clou
24	30 1	30 0	14 3	14 5	2 0	1 5	S. e.	1	S. e.	2	fair	fair
25	30 0	29 9	12 0	12 7	2 0	1 8	S. e.	2	S. e.	2	fair	fair
26	29 7	29 8	13 0	13 7	1 9	1 4	S. w.	2	S.	2	clou	fair
27	29 9	29 9	13 5	13 3	1 6	1 7	S.	3	S.	3	clou	clou
28	30 1	30 1	13 9	14 2	1 9	1 5	W.	2	W.	1	fair	clou
29	30 2	30 3	13 6	13 9	1 8	1 3	N. w.	2	N. w.	2	clou	fair
30	30 2	30 2	10 6	10 1	1 9	1 5	N. e.	2	N. e.	2	clou	clou

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greateſt Height	30 3	14 5	3 1
Leaſt Height	28 9	8 5	1 3
Height at a Medium	29 8	11 5	1 9

MAY, 1736.

Day.	Barom.		Thermom.		Hygrosc.		Wind.				Weath.	
	For^n.	Aft^n.	For^n.	Aft^n.	For^n.	Aft^n.	Forenoon.		Afternoon.			
	I. D.	I. D.	I. D.	I. D.	I. D.	I. D.	Direct.	fo.	Direct.	fo.	Fo.	Af.
1	30 2	30 1	10 2	10 4	1 3	1 2	N. w.	2	N. *b* w.	2	clou	fair
2	30 0	30 0	10 9	10 6	1 4	1 3	N. *b* w.	2	N. *b* w.	2	clou	fair
3	29 9	29 8	10 4	12 2	1 3	1 1	N. w.	2	N. w.	2	fair	fair
4	29 8	29 8	10 3	10 8	1 4	1 5	N. w.	2	N. e.	2	clou	clou
5	30 0	30 0	11 5	11 4	1 5	1 4	N. e.	2	N. e.	2	clou	clou
6	30 0	29 9	11 3	10 4	1 5	1 3	N. e.	2	N. e.	2	fair	clou
7	29 9	29 8	12 0	11 5	1 5	1 4	N. e.	2	N. e.	2	fog	fair
8	29 7		11 8		1 3		N. e.	2			fair	
9	29 7	29 8	11 0	10 7	1 5	1 4	N. e.	2	N. e.	2	fair	fair
10	29 8	29 8	10 9	10 7	1 7	1 8	N. e.	2	N. e.	2	fair	fair
11	29 8	29 7	10 0	10 8	2 0	1 7	N. e.	2	N. e.	2	rain	clou
12	29 6	29 6	11 1	10 8	1 6	1 7	N. e.	2	N. e.	2	rain	fair
13	29 7	29 6	11 9	10 9	1 7	1 8	N. e.	2	N. e.	2	clou	clou
14	29 6	29 5	11 7	11 6	2 1	2 7	N. e.	2	E.	2	fair	haz
15	29 5	29 5	11 5	11 8	3 4	3 2	E.	3	E.	1	fog	rain
16	29 6	29 6	13 1	13 8	1 9	1 6	S. w.	2	S. w.	2	fair	fair
17	29 7	29 9	14 7	13 8	1 6	1 5	S. w.	2	W.	2	fair	fair
18	30 1	30 2	13 5	14 2	1 7	1 6	S.	2	E.	1	fair	fair
19	30 2	30 3	12 7	13 3	2 3	1 8	E.	2	E. *b* n.	2	fair	fog
20	30 3	30 2	12 3	13 3	2 9	1 6	E. *b* n.	2	E. *b* n.	2	fog	fair
21	30 1	30 0	11 8	11 5	2 2	2 0	E.	2	E.	2	clou	clou
22	29 9	29 8	11 6	11 6	1 9	1 9	E.	2	E.	2	clou	clou
23	29 7	29 6	12 3	12 3	1 9	2 1	E.	1	E.	2	fog	clou
24	29 6	29 5	13 3	13 0	2 1	1 5	E.	0	W.	3	clou	clou
25	29 5	29 5	12 2	12 6	1 5	1 1	W.	3	W.	3	fair	fair
26	29 3	29 3	12 6	12 6	1 4	1 4	S. w.	2	S. w.	2	clou	clou
27	29 4	29 5	13 2	11 7	1 4	1 7	E.	2	S. e.	2	clou	clou
28	29 7	29 8	12 6	11 9	2 0	2 1	N. e.	2	N. e.	2	clou	fair
29	29 8	29 8	13 1	12 0	2 0	3 2	N. e.	2	N. e.	2	clou	fog
30	29 9	30 0	12 5	13 5	2 4	1 8	N. e.	2	E.	2	fair	fair
31	30 0	30 0	14 2	14 9	1 6	1 5	N. e.	2	N. e.	2	fair	fair

	Barom. In. D.	Ther. In. D.	Hygr. In. D.
Greatest Height	30 3	14 9	3 2
Least Height	29 3	10 0	1 2
Height at a Medium	29 8	11 8	1 7

An account of the diseases which were most frequent in Edinburgh in the years 1731, 1732, 1733, 1734, *and* 1735.

1731.

THE sagacious Sydenham having classed epidemical distempers under such as make their appearance in the spring, or in the autumn, we shall begin our medical year at the summer solstice, when the spring diseases are worn out, and before the declension of the sun has brought on the product of the autumn.

In the year 1731, in the month of June, many were seized with a swelling in the face, and salivary glands, without any fever or redness of the skin, which gave way to a gentle purge or two.

In July and August, this swelling grew more of the erysipelas kind, and fell chiefly upon the forehead and eye-lids; but the skin was not high-coloured, nor the fever violent. This yielded to purges and blisters. Near a-kin to this were the ophthalmia, tooth-ach, pains in the head, and a slight rheumatism, which were pretty frequent, but not very acute, generally yielding to once bleeding, and a few purges. About the end of July, some agues appeared, which gave way to the common methods. In August, the bastard small-pox broke out among children, preceded by feverish symptoms, which were commonly very gentle, and the eruption easy. Some had a second eruption upon the first going off; others a third: but even this sort required little more than a cooling regimen. In this month, the cholera was pretty frequent, tho' gentle, and was cured by some doses of rhubarb. Dysenteries succeeded, often tedious, tho' rarely mortal. Repeated doses of ipecacuanha, of rhubarb with calomel, which often proved emetic, with an opiate every evening, were most successful. Astringent medicines, without gentle revulsions and evacuations, generally retarded the cure.

In

In October, a pleurisy became frequent. The pain was mostly external, increased by touching the part, or lying on the side affected. The violence and continuance of the pain, the hardness and frequency of the pulse, did not entirely yield to bleeding; but blisters on the part affected gave great relief. This disease at length degenerated into a pleuritic fever, in which the pain was neither so constant or acute as in the pleurisy; but the breathing was more difficult, and the pulse more disorderly, and often low. This disease was rather obstinate than mortal.

In November, a slow fever prevailed in town, but more in the neighbouring villages, attended with a violent pain of the head, a small quick pulse, deliriums, and watchfulness. Several of the elder sort died; but of the younger many voided worms, and recovered.

In December and January, a fever was frequent among the common people, which began with a diarrhœa. This, when neglected, sunk the pulse, brought on deliriums and watchings, which yielded neither to blisters, diaphoretics, or opiates; but, on the tenth or twelfth day, the patients died. Such as were early bled and vomited, and then took opiates, were well on the fifth or sixth day. Some had a diarrhœa without any fever; but this was carried off by vomits and purges. An inflammatory quinsy likewise, with an acute fever, was frequent, and was cured by plentifully bleeding in the beginning, and blistering. Sometimes it went off in natural sweats, after letting blood.

In February, the slow fever of November became more frequent and dangerous, and the symptoms more violent; to which were added tremulous motions and startings of the tendons, and bleedings at the nose, without relief. In most, the pulse was little and quick; in some scarce changed from the natural; in others the arteries were full, but contracted weakly; the urine was pale, without sediment. Remedies availed not unless early applied; but bleeding and vomiting at first, and afterwards blistering, prevented or abated the worst symptoms.

In

In March, the pleurify mentioned in October, raged with greater violence. The inflammation chiefly affected the mufcles, for the patients could not lie on the affected fide: but a thick, difficult, and painful breathing, a heat and oppreffion in the breaft, fhewed that a peripneumony was joined with it. It it probable that, in fome, the œfophagus, or ftomach, was inflamed, they having frequent and ftrong reachings to vomit. The pulfe was quick and low, changeable, and fometimes intermitting; the urine pale and little; the thirft great; the tongue foul and parched. Upon the firft bleeding, the fymptoms abated; the pulfe grew fuller and ftronger, but the return of the complaints foon required a fecond, and then a third bleeding, which often funk the pulfe fo low that it was difficult to raife it, unlefs blifters were inftantly applied, which fometimes brought on a fweat: this, when general and copious, carry'd off the difeafe; otherwife the patient ftruggled in agonies till his ftrength was loft. About this time, feveral difeafes, but none dangerous, attacked children. Coughs were univerfal among them, efpecially when the eaft wind blew, or fnow fell. Through this winter and fpring, perfons of all ages were more fubject to coughs, than ufual. The chincough, which had been violent at fome diftance from the town, advanced to the fuburbs, but was fcarce felt in the city, as it ufually happens, however frequent it may be all around it. Children got a fwelling in the face, neither œdematous nor inflammatory. On others, this fwelling fpread itfelf over the head, and fometimes the arms and lower extremities, where it created a painful itching. Emollient fomentations gave eafe, and gentle purges carried off the diforder. At the end of this month, a fhort, but acute fever, feized feveral children. This yielded to a cooling ptifan, or, at moft, once bleeding. The rheumatifm, and lumbago rheumatica, attacked fome grown perfons. But warm applications, bleeding, and bliftering, gave them eafe.

In April and May, the pleurify, flow fever, with the head-ach, and fome fevers, with a diarrhœa, the ery-

fipelas

ſipelas œdematodes, the cough, chin-cough, and ophthalmia, deſcribed in the former months, were ſtill to be found. Scarce any new diſeaſes appeared, only tertian agues were epidemic.

An account of the diſeaſes which were moſt frequent in the year 1732, *in Edinburgh.*

THE tertian agues, which were epidemic in April and May, continued thro' June. Towards the end of this month, they did not form regular paroxyſms and perfect intermiſſions, but appeared in the ſhape of a remitting fever. During the remiſſions, the pulſe ſunk; but grew fuller and ſtronger as the ſweats came on. When the ſweats did not break out, the patients became delirious, and ſome continued deaf for ſeveral days; the urine was pale, and without ſediment till the diſeaſe was going off. Some were cured after two or three paroxyſms, by a vomit or two; but with others the diſeaſe laſted longer. Vomiting and bliſtering ſucceeded better than bleeding, either of them bringing out a ſweat.

In July, a few agues remained, but they were more regular and gentle than before. Towards the end of this month, the cholera began to appear, but was neither very frequent nor violent.

In Auguſt, many of the poor in the ſuburbs and villages were taken with ſlow fevers, generally attended with a violent head-ach and delirium, ſome with a diarrhœa, others with rheumatic pains all over the body. Several, not having timely aſſiſtance, died in this diſtemper. This fever continued thro' September and October, and proved mortal the eighth or ninth day. Many complained of great weight in their heads, and drowſineſs, loathing, and vomiting; others of pains in the breaſt, and difficult breathing. Children, beſides the head-ach and drowſineſs, had pains in the belly, with a hard ſwelling. Moſt of them voided worms, ſome the teretes, others the aſcarides, and recovered.

In

In November, ſeveral children had ſlight aguiſh fits every other day, which went off in a few hours without ſweating; between the paroxyſms they were eaſy, and their pulſes calm. A vomit or two carry'd off the fits. A cholera attacked ſeveral people, but was eaſily removed. The effects of cold appeared in coughs, quinſies, rheumatic pains, colic pains, diarrhœas, &c.

From the beginning, to the middle of December, ſlow fevers were rife among young people; they continued long with pains in the breaſt, ſymptomatic diarrhœas, but were not fatal: others were ſeized with nervous fevers, with a frequent, but low pulſe. On the 17th of December many were attacked with fevers of cold. The numbers increaſed but ſlowly to the 25th, when theſe fevers became epidemic, and continued ſo to the middle of January, when they decreaſed daily to the end of the month. This fever began with a coldneſs, ſhivering, ſwimming of the head, pains of the head, breaſt, and back; the pulſe was frequent; the appetite loſt, or palled, ſometime after the diſeaſe was removed. With many it began with a running, at the eyes and noſe. This continued for a day, then their throats ſwelled, and grew painful, and ſoon a cough began: many were ſuddenly ſeized with the cough, which after the third day was inceſſant and conſtant in all. Large quantities of mucus were diſcharged, and their pains greatly increaſed, ſome had ſharp ones in their bellies, a diarrhœa, ſometimes with bloody ſtools, eſpecially if they were not ſufficiently blooded in the beginning. The urine of ſeveral was in ſmall quantity, high coloured, without ſediment, and continued ſo after the fever was gone off. Many children had with the cough violent vomitings, ſome a gentle diarrhœa, which carried off the diſeaſe. The fever commonly left the ſick in two or three days, but after the third ſcarce any eſcaped the cough; moſt of them inclined to ſweat, and were thereby relieved. Some, without any previous coldneſs, ſhivering, &c. ſweated profuſely with copious reddiſh or brown, but not la-

 teritious

teritious ſediment in their urine. Theſe ſoon did well if the ſweating was not diſcouraged by ſome evacuation. Bleeding in the beginning relieved the pains and abated the fever, and many who had violent head-achs, and a ſenſation in their eyes, as if they would have ſtarted out, or who had an univerſal oppreſſion of the thorax, were ſeized with an hæmoptoe, if they delayed venæſection too long. Some bled a little at the noſe, and grew quickly well without any medicine. A few were ſeized at once with faintings, and recovered ſlowly if bled; but ſoon grew well with cordials. Veſicatories abated the cough, and opiates cured ſeveral. When the phlegm began to thicken, the ordinary pectorals and balſamics did no good, but gum ammoniac and oxymel ſcilliticum opened the belly, and did great ſervice. This diſeaſe, tho' not of itſelf mortal, ſwept away a good number of poor, old, and conſumptive people, and of thoſe who were much waſted by other diſtempers. It was remarkable that people in our priſon, and the boys in Heriot's hoſpital, eſcaped this fever and cough. This diſeaſe was felt firſt at Edinburgh, from thence it ſpread itſelf over all Scotland. It did not reach the moſt northern and weſtern parts, till fifteen days after its attacking this city. The horſes in and about this place were univerſally attacked with a running of the noſe, about the beginning of November, before the appearance of this fever among men.

Some people laboured under fevers of the pleuritic kind, and others under ſlow ones in the month of January.

In February rheumatic and pleuritic fevers ſucceeded to the colds; ſeveral who had paſſed thro' thoſe, died of theſe. About this time ſeveral died ſuddenly.

The pleuritic and peripneumonic fevers continued thro' all March, and ſlow fevers were frequent without any topical inflammation. The ſymptoms in theſe fevers were not violent, tho' ſome had deliriums, but they were neither conſtant or high. Theſe fevers often laſted till the thirtieth or fortieth day, and often to the ſixtieth. At length the patient got thro' them with-

out

out any crisis. The common remedies availed but little. Blistering was of more service than bleeding. Tertian agues appeared in March, and continued thro' April, and part of May. Many of them went off easily after a few fits, without much assistance. Some short, but acute fevers, were frequent in April, attended with an erysipelas. Some children had the small-pox in May, generally of the distinct kind. Several had an eruption like the chicken-pox. The fever was small, and the symptoms slight; after a little heaviness, and loss of appetite, large and red pustules appeared. They did not suppurate, but had a little bladder of clear lymph on the top. Some new pustules appeared for four or five days, but about the ninth they all went off.

Account of the diseases which were most frequent in the year 1733, *in Edinburgh.*

IN June, several inhabitants of Edinburgh were seized with tertian agues. Others had slight fevers, with a pain of the head, and flying pains thro' the body. The sick having short remissions of the fever, and partial sweats. Scarlet fevers, with sore throats, were frequent in several parts of this city.

In July, quincies, coughs, hoarseness, and the like disorders were frequent. The scarlet fever, and quincy, attacked children, and became epidemic in the two succeeding months, and continued all the winter and spring. It began with a quick pulse, heat, thirst, head-ach, and a pain in the throat, where frequently a swelling of the amygdalæ was observed. Many had a vomiting, and diarrhœa at first, without any change of the other symytoms. After a day or two the face or extremities, and sometimes the whole body, swelled, the skin being red, with a watery clearness. Frequently the swelling and redness moved gradually from one part to another. Such who had undergone the scarlet fever any time before, took the fever and quincy without the eruption; but all who had the fever had the quincy also. Many who were neglected in the begin-

 ning

ning of this disease were suffocated. Few died who were timely and plentifully blooded, which abated the fever, relieved the throat, and was the only means which removed the vomiting and diarrhœa. After the pulse was brought low, blisters were of use, and the cure was hastened and compleated by aperient laxative ptisans. The small-pox, which encreased in May, continued to do so in June, July, and August, but were generally of the distinct mild kind.

In September they were more frequent, and more of them confluent. They continued increasing all October; after which they raged violently till February, when they decreased, and went off in March. The pimples generally appeared the third day, and yet were not always either confluent or dangerous. Very few had any purple spots, and of those who recovered, fewer had tumors or ulcers than at other times. The cool regimen was generally followed; and when the fever was high in the beginning, with the head or breathing much affected, the patients were commonly blooded and vomited; and in the confluent kind, it proved useful to repeat blooding in the height of the disease, and some time after. From the first attack of the fever, till the small-pox were all out, many ordered pediluvia of warm water once or twice a day, which seemed to relieve the head considerably, and to bring a great number of pimples to the lower extremities. When the patients were costive, diluting cooling clysters were injected. Syrup of white poppies was generally given at night to procure sleep. In some who had bloody stools and urine, spirit of vitriol mixed with their drink did service; these symptoms disappearing in a little time after their taking it. Blisters assisted the eruption, when the pulse was low, and removed delirium, startings of the nerves, convulsions, and difficulty of breathing; some who had a bad confluent small-pox seemed to have the dangerous symptoms at the turn prevented, by application of vesicatories a day before they turned colour, and by keeping up a suppuration in the blistered parts for some days. Gentle

emetics

emetics were of uſe when the ſtomach or lungs were over-charged with mucus. When the ſmall-pox were empty, or had only a little watery matter in them, and the ſwelling began to fall ſuddenly on the ninth or tenth day, purgatives were given to ſome with good ſucceſs.

Though bleeding in the beginning of the ſmall-pox gave relief in many caſes, yet it could not be judged whether it had any effect in determining the nature or number of the ſmall-pox; for many, who had been prepared by bleeding, purging, iſſues, and low cooling diet, had a very bad confluent ſmall-pox; while others, who had been treated in the ſame manner, and many who had uſed no ſuch precautions, took the mild kind. Some who had undergone courſes of mercury, and who had been afterwards kept, for a conſiderable time, to the conſtant uſe of Æthiops mineral, were ſeized with the confluent ſmall-pox, and died.

During the harveſt months of 1733, dyſenteries were frequent and mortal in Fife, eſpecially on the coaſt of the frith of Forth.

In March and April 1734, irregular tertian agues became frequent in Edinburgh; but repeated vomits either carry'd them off, or made them eaſily yield to the bark. At the ſame time many children in the neighbouring villages were ſeized with an acute fever, and high laborious breathing, which ſoon killed them, unleſs timely relieved by frequent and plentiful bleeding, and gentle vomits.

An account of the diſeaſes that were moſt frequent in the year 1734, *in Edinburgh.*

THE tertian ague, which began in March, continued till the warm weather in June put an end to it.

In May, June, and July, ſeveral children in the neighbourhood, and ſome within the city, laboured under the tuſſis convulſiva. In Auguſt, more were attacked by it. In September, it became more frequent; and in October, few in the villages eſcaped it. It was frequent all winter within the town, and ſeveral adults

were ſeized with it. The method of cure, chiefly followed, was, to keep themſelves empty, by evacuations, which rather prevented the diſeaſe from proving fatal, than ſhortened it; for notwithſtanding the cough continued ſeveral months. However, there was generally a remiſſion for ſome days, after bleeding or purging, eſpecially when the purgatives worked upwards, as well as downwards. Pectorals, balſamics and attenuants, did little or no good. Opiates rather did hurt. A great many ſpecifics were employed without any ſucceſs. Other kinds of coughs were rife, and difficult to remove through the winter. Rheumatic pains and ſtitches, ſome with, others without a fever ſeemed to begin, continue, and decreaſe with the cough. Repeated bleeding, and antiphlogiſtic purgatives, with diluting and attenuating medicines, proved the moſt effectual remedies. Towards the end of September, and in October, many were ſeized with a dyſentery. It had the ordinary ſymptoms of a ſlight fever, frequent ſtools, bloody, and mucous, violent gripes, and a teneſmus. This diſeaſe was fatal to ſome, tedious to others who neglected evacuations, and had too ſoon recourſe to opiates and aſtringents. The common practice was to bleed, vomit with ipecacoanha, purge with rhubarb, and to give opiates ſometimes in the intervals. In ſome caſes, where this method failed, the vitrum antimonii ceratum had ſucceſs. In October, there were ſome fevers of a bad kind, in which the head was much affected, the pulſe low; bliſters were of little ſervice, and the ſick could not bear bleeding.

In February agues began, increaſed in March and April, and then gradually went off. Some remitting fevers were likewiſe obſerved. In the end of March, and beginning of April, many children were ſeized with an irregular fever. They were ſometimes hot, then cold; their pulſe was now quick, ſoon after moderate; ſometimes they had difficult breathing, thirſt, and purging; at other times they were free of theſe ſymptoms. Notwithſtanding any medicines, which were given, the diſeaſe continued about ten days, then terminated

minated in a cough, which remained ſome time with moſt, and was very difficult to remove in others.

Account of the diſeaſes which were moſt frequent in the year 1735, *in Edinburgh.*

AGUES, which were common in the ſpring, did not ceaſe, tho' they became leſs frequent in the ſummer, and then proved tedious, and returned when the bark was given too ſoon. About the twentieth of June the meaſles appeared, and ſoon become very rife. They were frequent all July and Auguſt, decreaſed afterwards, but did not leave the town till ſpring. In December, they were univerſal in the country about Edinburgh. The ſymptoms, preceding this diſeaſe were a hard, dry cough, muddy moiſt eyes, irregular ſhort attacks of liſtleſſneſs and inactivity. The duration of theſe was very uncertain from one day to fourteen. The eruptive fever continued one, two, or three days, attended with ſneeſing, itching, inflammation of the palate and tonſils; ſome bled at the noſe, others had a diarrhœa. The exanthemata were of the common form generally, but in ſome they roſe above the ſurface of the ſkin. None of them ſuppurated. Upon the eruption, the fever, cough, and angina abated, but went not off till the decline of the diſeaſe. The eruption advanced three, four, or five days, and then declined, after which was the greateſt danger; for in ſeveral the cough returned more violent, a peripneumony and diarrhœa came on; but in moſt the diſeaſe declined gradually, without any bad ſymptoms, and, in general, the meaſles were mild during this ſeaſon. As to the cure, a cool regimen was kept all the time of the diſeaſe; and unleſs the ſymptoms were mild, the patient was blooded and vomited. If coſtive, clyſters were given. If there was a diarrhœa, bloodletting, vomits, and decoctum album generally put it away. Emollient pectorals, and ſyrup of diacodium, made the cough eaſier. When the defluxion became tough, vinegar of ſquills was added. If the angina was violent, gargariſms and pultices were uſed. When

a peripneumony, delirium, or ſtupor, followed the ſudden diſappearance of the meaſles, if the pulſe was high, bleeding gave relief; if low, bliſters, and the meaſles re-appeared; but in ſome, not till ſeveral days or weeks after. In a peripneumony, on the decline of the diſeaſe, blood-letting when the pulſe was high, and bliſtering when it was low, were the principal remedies. A diarrhœa, upon the decline of the meaſles, ſeldom did good, waſted the patients, and proved difficult to ſtop. Rhubarb, and mercurius dulcis were the moſt effectual remedies. After the meaſles begun, two or three purgatives were uſually given. To thoſe who ſeemed to be hectic, and threaten'd with a phthiſis, vomits, peruvian bark, and aſſes milk, were of ſervice. During this ſeaſon, ſeveral had all the preceding ſymptoms of the meaſles, without any eruption, which they underwent months or years after. Others, who had the meaſles formerly, had a fever of the eryſipelatous kinds, with all the ſymptoms of the meaſles, from the beginning to the end of the diſeaſe.

In June and July were ſome pleuriſies, and ſlight catarrhs. In July, ſeveral had a ſlow fever, with a low pulſe, with a diarrhœa, either at the beginning or end of it, or during all the time. The cure depended principally on vomits and bliſters.

The cholera and chin-cough were frequent near the town. In Auguſt and September, ſome few people had coughs, rheumatical fevers, and quincies. In October, November, and December, ſeveral had the dyſentery; the ſymptoms and method of treating of which, were nearly the ſame as in the preceding year. Some, after bleeding and vomiting, gave their patients ſmall doſes of aquila alba once a day, till their breath began to be tainted; the purging being moderated by opiates, glutinous food, drink, and anodyne clyſters, which were the more neceſſary, as the guts were eaſily irritated. Notwithſtanding the ſymptoms were violent, this diſeaſe was fatal to few.

From the beginning of October, to the beginning of February, a fever was frequent in town; the ſick had generally a low pulſe on the firſt two or three days,

days, a great anxiety and uneafinefs; the urine was thin and crude; a delirium began about the fourth, and continued till the fever went off in the feventh day, and fometimes not till the fourteenth. A limpid urine, and without fediment, foretold the delirium. The fymptomatic fweats did, for the moft part, harm; the patients were uneafy in them, and weaker after, and the fever not abated. In fome, thefe fweats abated the fever, and returning, carry'd it off; a plentiful fweat was the crifis to feveral; in others, there was no crifis obferved. For the moft part, there was no fediment in the urine, till feveral days after the fever feemed to be gone; they who had a plentiful fediment recovered well, others were expofed to frequent relapfes, rather more dangerous than the former fever.

Bleeding, in the beginning, was of fervice, not only to thofe who had a ftrong pulfe, but even to fuch whofe pulfe was low; the pulfe rifing after bleeding, and the anxiety which they laboured under, going off, the liberal ufe of blifters promoted the cure. The critical fweats being forwarded by diluting drinks, and gently ftimulating medicines, fuch as rad. ferpent. valerian. caftor, fal fuccini, &c. Clyfters alfo were given from time to time to empty the inteftines, and affift the urinary organs. After the fever was gone, the fick generally were fatigued with conftant watching. Opiates were of no fervice, but ten grains, or a fcruple of caftor, procured fleep.

Catarrhs, coughs, quincies, rheumatic pains, and flight fevers, made their cuftomary appearance. Pleurifies, and rheumatic fevers, were frequent in February; the cure was by letting of blood, bliftering, and attenuating diluters.

In February, a pleurify, which had fomething uncommon in it, was frequent in Fife, and at firft proved very fatal. It began with a fhivering, head-ach, and bilious vomiting, which, after two days, were fucceeded by a pungent pain among the ribs, a difficulty in breathing, and a fhort cough. If the fick kept in bed, his tongue grew white and foul, otherwife it continued moift. The thirft was moderate, if no blood

was

was taken away; but when as much was taken as the degree of pain required, the thirſt increaſed, as did likewiſe the ſickneſs at the ſtomach, till the patient fainted. The pulſe, which was neither frequent, nor full, quickly ſunk on letting blood, which was of a browniſh, yellowiſh, or greeniſh colour, and hardly coagulated. The belly was regular, the ſpittle tough and white, and the cheeks alternately fluſhed. The ſick never ſlept through the whole courſe of the diſeaſe, which continued from twenty-five to thirty-two days. When little or no blood was taken away, and vomits were given early, with expectorating nitrous liquors, and attenuating pectorals, when the ſtomach could bear them, the patient generally recovered. If the emetics were ſtrong, they brought ſuch a quantity of thick phlegm upon the lungs, as endangered ſuffocation.

In March, April, and May, coughs were frequent, attended with a fever. Bleeding, repeated vomits, bliſters on the ſhoulders, cooling purgatives, and attenuating pectorals, were ſucceſsful remedies, when timely employed.

Extract from the regiſter of burials in Edinburgh, from the year 1731, *to* 1736.

		Men.	Wom.	Child.	Still-born.	Sum.
1731	June	17	27	35	5	84
	July	19	32	33	5	89
	Auguſt	26	26	27	2	81
	September	17	30	38	3	88
	October	12	19	23	1	55
	November	20	27	38	1	86
	December	28	23	40	3	94
1732	January	36	26	25	3	90
	February	35	32	38	3	108
	March	23	31	46	4	104
	April	29	26	58	3	116
	May	34	34	51	5	124
	Total	296	333	452	38	1119

		Men.	Wom.	Child.	Still-born.	Sum.
1732	June	23	32	27	0	82
	July	16	21	37	5	79
	Auguſt	19	20	39	2	80
	September	15	32	20	4	71
	October	20	19	32	4	75
	November	24	28	33	4	89
	December	31	41	34	3	109
1733	January	56	81	74	3	214
	February	40	44	48	3	135
	March	36	42	34	5	117
	April	20	28	41	2	91
	May	19	26	57	3	105
	Total	319	414	476	38	1247

		Men.	Wom.	Child.	Still-born.	Sum.
1733	June	19	29	40	4	92
	July	17	19	41	2	79
	Auguſt	20	26	63	4	113
	September	13	21	65	3	102
	October	15	26	106	6	153
	November	19	27	144	8	198
	December	21	27	116	4	168
1734	January	26	46	80	3	155
	February	22	23	57	4	106
	March	28	27	66	4	125
	April	25	31	50	3	109
	May	31	46	41	9	127
	Total	256	348	869	54	1527

		Men.	Wom.	Child.	Still-born.	Sum.
1734	June	10	25	28	5	68
	July	18	18	22	9	67
	Auguſt	18	21	39	4	82
	September	18	21	34	6	79
	October	28	34	39	4	105
	November	24	35	41	5	105
	December	27	36	51	4	118
1735	January	25	38	48	4	115
	February	21	18	53	5	97
	March	25	37	61	6	129
	April	17	21	53	3	94
	May	13	29	46	2	90
	Total	244	333	515	57	1149

		Men.	Wom.	Child.	Still-born.	Sum.
1735	June	13	22	34	3	72
	July	14	18	50	9	91
	Auguſt	12	26	70	2	110
	September	13	28	50	5	96
	October	15	19	44	3	81
	November	13	27	58	4	102
	December	13	21	50	10	94
1736	January	28	32	31	0	91
	February	26	26	27	3	82
	March	27	33	32	3	95
	April	25	26	51	5	107
	May	19	30	43	8	100
	Total	218	308	540	55	1121

A comparison of the meteorological registers and epidemic diseases at Edinburgh, Rippon, Plymouth, and Norimberg, from May 1731, *to June* 1736, *by Mr. Patrick Ker, student of medicine in the university of Edinburgh.*

THE description of Edinburgh, which is prefixed to the meteorological register, is very exact; but I find no such accurate account of the other places in which the registers were kept.

Rippon is an inland town in Yorkshire, situated 1° 43′ farther south, and 1° 30′ farther east than Edinburgh; between 80 and 100 miles distant from the German ocean on the one side, and the Irish sea on the other.

Plymouth, a sea-port in Devonshire, is 5° 25′ south of Edinburgh, and 1° 20′ west of it, situated near the chops of the British channel, which is to the south of it. By the situation therefore of Edinburgh, Rippon, and Plymouth, they seem to be very proper for making observations; by comparing which together, some assistance may be got for accounting for the changes in our British atmosphere and bodies.

Norimberg is a large city of Franconia, about 6° south, and 14° east of Edinburgh, situated at a great distance from any sea, the nearest not being within 300 miles of it.

From observations made with the barometer, it appears, that Norimberg is placed about 700 feet higher than Edinburgh, so that the atmosphere of the first place is $\frac{1}{37}$ lighter than that of the latter; and that the barometer at Plymouth stands 230 feet lower than that of Edinburgh. The different heat of these places is difficult to be determined, as the observations are not accurately calculated to determine the hottest and coldest times of each day. Dr. Huxham's thermometer may be compared with the Edinburgh one, by the help of Dr. Martin's table (a); but the thermometer made

(a) See Martins.

made use of in the Norimberg obſervations, is conſtructed ſo as not to admit of a juſt compariſon. From the latitude, and accounts given, the ſummer ſhould be warmer, and the winters colder, than ours; and ſuch a difference there is between Dr. Huxham's obſervations and theirs, though Plymouth is only about one degree different in latitude from Norimberg.

The moiſture of the air in theſe different places is worſe to compare; for the Norimberg gentlemen have no hygroſcopical obſervations, and Huxham's hygroſcope has not two fix'd points, ſo that I could only gueſs at a compariſon; by which it appears, that Plymouth is more moiſt than Edinburgh. At Edinburgh, the greateſt moiſture is when the wind blows from the eaſterly quarter; and the drieſt air is with north-weſt winds. At Plymouth, the eaſt, and north-eaſt winds are the drieſt, and the ſouth-eaſt, ſouth, and ſouth-weſt, are the moſt moiſt.

Neither Huxham, nor the Norimberg ſociety, has any meaſure for rain. By Huxham's obſervations, compared with thoſe at Edinburgh, it appears, that more rain falls at Plymouth than at Edinburgh: at a medium of four years, the rain at Plymouth was to that at Edinburgh, as 30.909 inches to 22.518 inches.

At Edinburgh, the winds are generally from the weſt, ſouth-eaſt, and north-weſt; only in the months of March, April, May, and June, the eaſterly winds are frequent. At Norimberg, the eaſterly winds blow oftener in October, November, December, and January, than in any other months in the year. The weſterly, ſoutherly, and northerly winds prevailing at other times. The ſtrongeſt winds, both at Edinburgh and Plymouth, are generally from the ſouth-weſt.

In the following tables Ed. ſtands for at Edinburgh, Pl. for Plymouth, Nor. for Norimberg, V. for wind, Med. for height at a medium, G. H. for greateſt height, and L. H. for leaſt height.

JUNE

JUNE 1731.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermomer. Med.	Thermomer. G. H.	Thermomer. L. H.	Rain.
Edinb.	29 5	30 1	29 1	13 2	16 0	10 6	2 055
Plym.	29 $4\frac{25}{26}$	30	29 1	15 5	16 0	14 5	2 148

Air { Ed. to 12 day dry, V. S.W. and W. after, moift, V. E. and N. E.
Pl. to 20 day dry, V. E. and N. after. moift, V. S. W.

JULY.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 7	30 0	29 4	14 2	16 2	12 6	1 541
Plym.	29 $5\frac{14}{29}$	29 8	29 3	16 0	17 1	14 7	1 300

Air { Ed. dry, V. W. and S. W.
Pl. dry - - - - - - - - variable.

AUGUST.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 7	30 1	29 4	13 5	15 7	11 9	1 857
Plym.	29 $4\frac{12}{30}$	29 9	29 0	16	17	14 4	1 988

Air { Ed. to 9.d. moift, V. E. to 18.d. dry. V. N.W. and W. aft. moift, V. E.
Pl. dry, V. E. afterwards moift, V. S. E.

SEPTEMBER.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 6	30 2	29 0	12 9	14 7	10 7	2 021
Plym.	29 $5\frac{19}{25}$	30	29 2	15 5	15 7	13 9	1 300

Air { Ed. dry, V. W. and N. W. or S. W.
Pl. dry, begin. V. S. W. after 11 day, E.
Rip. moift, V. S.

OCTOBER.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.							1 479
Plym.							2 366

Air { Ed. to 20 dry, V.W. and S.W. to end moift, V. S. and S. E.
Pl. to 11 V. W. to 27 S. E. to end S. W.

NOVEMBER.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 8	30 3	28 0	9 8	12 6	7 4	1 422
Plym.	29 $6\frac{29}{2}$	30 2	28 7	12 7	14 3	10 3	2 356

Air { Ed. moift. V. W. and S. W. and fometimes E.
Pl. dry, V. to 5, W. to 12, E. to 23, N.W. or S.W. to the end N. E.

DECEMBER.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 5	30 2	28 9	9 0	11 7	5 7	3 125
Plym.	29 8	30 2	29 4	11 8	14 8	10 2	1 452

Air { Ed. moift, V. W. and S. W. fometimes E.
Pl. dry, V. N. W. or N. E. fometimes S. W.

JANUARY 1732.

	Med.	G. H.	L. H.	Med.	G. H.	L. H.	Rain.
Edinb.	29 3	30 2	28 9	8 8	11 5	6 8	1 283
Plym.	29 6	30 0	28 9	11 5	12 7	9 5	3 564
Norim.	28 68	29 1	28 33				

Air { Ed. moift, V. to 7, E. and S.E. and N.E. to 11, W.S.W. to 20, E. to end W.
Pl. dry, V. in beginning N. E. afterwards S.
Nor. V. to 11, N. E. to 15, N. to the end, N. E. and N. N. E.

FEBRUARY

FEBRUARY 1732.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 4	30 2	28 7	10 4	12 8	8 6	2 409
Plym.	29 7	30 1	29 1	12 8	13 7	11 8	3 564
Norim.	28 7	29 2	28 34				

Air { Ed. to 20 moist, then drier, V. S. W.
Pl. wind W.
Nor. wind variable.

MARCH.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 6	30 1	29 2	10 4	13 6	7 6	0 793
Plym.	29 $6\frac{3}{30}$	30 2	28 8	12 8	13 8	10 4	3 174
Norim.	28 72	29	28 1				

Air { Ed. mean, V. variable.
Pl. dry, V. variable N.
Nor. V. to 15, W. N.W. and N. N.W. to end N. E. N. N. E.

APRIL.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 5	30 0	29 1	10 8	13 2	9 0	3 106
Plym.	29 $4\frac{10}{29}$	29 7	29 2	13 7	14 5	12 3	2 196
Norim.	28 61	28 9	28 32				

Air { Ed. to 13 moist, V. E. to 18 dry, V.N.W. to end m. E.N.E. or S.E.
Pl. in begin. and end dry, from 18 to 24 moist V. S.
Nor. to 12 V. N. E. N. N. E. to end W. and N. N. W.

MAY.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 5	29 9	29 0	12 2	14 6	9 1	4 627
Plym.	29 $4\frac{20}{31}$	29 7	28 8	14 2	14 8	12 7	2 424
Norim.	28 7	28 97	28 23				

Air { Ed. dry, wind variable.
Pl. from 6 to 22 dry.
Nor. V. variable.

JUNE.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 8	30 3	29 4	14 1	15 9	12 0	1 196
Plym.	29 $6\frac{3}{29}$	30 0	29 0	15 6	16 5	14 2	1 270
Norim.	28 8	28 95	28 55				

Air { Ed. very dry, V. variable.
Pl. to the 18 very dry, from 5 to 12 V. E. from 19 to 22 W. aft. N.
Nor. V. W. S. W. N. W.

JULY.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 7	30 1	29 2	13 9	16 1	11 7	3 199
Plym.	29 $5\frac{13}{31}$	29 8	29 0	15 8	16 7	14 5	2 288
Norim.	28 82	29 0	28 55				

Air { Ed. dry, V. W. S. W. N. W.
Pl. in begin. and end dry, V. N. from 8 to 14, S.
Nor. to 17 V. variable to end, W, S. W, N. W.

AUGUST

AUGUST 1732.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 9	31 1	29 3	13 3	15 6	11 5	1 625
Plym.	29 $5\frac{10}{30}$	29 9	29 2	16 1	16 8	14 5	0 362
Norim.	28 85	29 13	28 73				

Air { Ed. generally dry, V. variable.
Pl. in begin. and end v. dry, V. E. from 9 to 26, V. variable.
Nor. to 8 V. N. W. to 16, S. E. to 22, N. E. to end variable.

SEPTEMBER.

Edinb.	29 6	30 3	28 3	12 2	14 6	9 8	No reg. of rain kept this m. at Ed:
Plym.	29 6	30 1	29 0	15 0	15 9	13 6	
Norim.	28 84	29 26	28 24				

Air { Ed. dry, V. W. S. W. N. W.
Pl. to 10, V. N. E. to 20, S. W. N. W.
Nor. to 9, V. E, N. E. to end W, S. W.

OCTOBER.

Edinb.	29 3	30 1	28 9	11 1	12 7	9 5	2 523
Plym.	29 $2\frac{25}{29}$	29 8	28 7	14 5	15 1	12 4	6 342
Norim.	28 38	29 2	28 54				

Air { Ed. moiſt, V. S. W. W. and ſometimes S. E.
Pl. V. in general S. end dry, V. N. E.
Nor. V. E, S. E, N. E.

NOVEMBER.

Edinb.	29 8	30 4	29 4	9 3	10 6	7 2	0 415
Plym.	29 9	30 4	29 4	12 0	13 0	10 7	0 584
Norim.	28 74	29 16	28 27				

Air { Ed. to 17 moiſt, V. S. S. E. W. to 21 dry, V. N. W. to end moiſt V. W.
Pl. very dry, V. E. N.
Nor. to 15 V. E, N. E. to end S. W, W, S. W.

At Rippon, in the end of November, there was a little ſnow, with froſt, for two weeks; after which it was uncommonly warm, dry, and pleaſant, till the end of December, when there was a little froſt, and ſnow again.

DECEMBER.

Edinb.	29 8	30 4	28 2	9 1	11 8	6 6	3 617
Plym.	29 $5\frac{20}{28}$	30 2	28 8	12 7	13 7	10 4	4 918
Norim.	28 74	29 13	28 33				

Air { Ed. to 18 moiſt, V. variable, to 26 v. m. V. S. E. to end m. V. S. W, W.
Pl. in begin. v. dry, V. N. E, E. from 16 to end moiſt, V. S. W, S.
Nor. V. E, N. E.

JANUARY 1733.

	Barometer. Med.		Barometer. G. H.		Barometer. L. H.		Thermometer. Med.		Thermometer. G. H.		Thermometer. L. H.		Rain.	
Edinb.	29	8	30	2	29	0	9	6	12	1	7	0	1	370
Plym.	29	$7\frac{20}{31}$	30	2	29	3	12	6	13	2	10	8	2	384
Norim.	28	97	29	42	28	25								

Air { Ed. moiſt, V. S. W.
Pl. in begin. moiſt, from 16 to 25 dry, V. E.
Nor. V. E, N. E, S. E.

At Rippon, there was very little rain, and the weather was uncommonly warm and pleaſant.

FEBRUARY.

	Barometer. Med.		Barometer. G. H.		Barometer. L. H.		Thermometer. Med.		Thermometer. G. H.		Thermometer. L. H.		Rain.	
Edinb.	29	6	29	8	28	8	9	9	11	7	8	5	2	525
Plym.	29	$16\frac{20}{26}$	30	0	29	2	12	3	12	9	11	2	3	734
Norim.	28	87	29	25	28	42								

Air { Ed. moiſt, V. S. W.
Pl. moiſt, V. W.
Nor. V. W, S. W, N. W. from 20 to 25, V. E, N. E.

MARCH.

	Barometer. Med.		Barometer. G. H.		Barometer. L. H.		Thermometer. Med.		Thermometer. G. H.		Thermometer. L. H.		Rain.	
Edinb.	29	6	30	2	29	1	9	9	12	5	7	4	2	638
Plym.	29	$4\frac{2}{28}$	30	2	28	9	12	4	13	7	10	8	3	098
Norim.	28	55	29	5	27	99								

Air { Ed. very moiſt, V. E, S. E.
Pl. from 8 to 22 dry, V. N. after. moiſt, V. S. E.
Nor. V. W, S. W, N. W, ſometimes E, N. E.

APRIL.

	Barometer. Med.		Barometer. G. H.		Barometer. L. H.		Thermometer. Med.		Thermometer. G. H.		Thermometer. L. H.		Rain.	
Edinb.	29	7	30	2	29	2	11	6	13	4	10	3	0	818
Plym.	29	6	30	0	29	1	13	8	14	5	12	7	2	284
Norim.	28	54	29	4	28	47								

Air { Ed. moiſt, V. E, N. E, S. E.
Pl. dry, V. E.
Nor. to 21 V. variable, to end N. W.

MAY.

	Barometer. Med.		Barometer. G. H.		Barometer. L. H.		Thermometer. Med.		Thermometer. G. H.		Thermometer. L. H.		Rain.	
Edinb.	29	8	30	2	29	9	12	7	15	9	10	7	0	083
Plym.	29	$5\frac{10}{27}$	29	8	29	2	14	4	16	1	13	5	1	010
Norim.	28	70	29	7	28	43								

Air { Ed. dry, V. E, N. E, S. E.
Pl. very dry, V. E.
Nor. V. N. W.

JUNE

JUNE 1733.

	Barometer.			Thermometer.			Rain.
	Med.	G. H.	L. H.	Med.	G. H.	L. H.	
Edinb.	28 8	30 0	28 9	14 2	16 1	12 6	2 138
Plym.	29 $4\frac{28}{36}$	29 8	28 8	16 1	16 7	14 9	1 534
Norim.	28 96	29 9	28 55				

Air { Ed. very dry to 13, V. E. to end, S. W, W.
Pl. in begin. and end dry, V. frequently E. often W.
Nor. V. N. W.

JULY.

	Barometer.			Thermometer.			Rain.
Edinb.	29 7	30 1	29 4	14 6	15 8	12 2	0 638
Plym.	29 $4\frac{6}{26}$	29 7	29 0	16 7	18 0	15 1	0 772
Norim.	28 81	28 97	28 51				

Air { Ed. dry, V. W.
Pl. very dry, V. N. E, N. W. ſometimes S.
Nor. V. N. W, S. W, W.

AUGUST.

	Barometer.			Thermometer.			Rain.
Edinb.	29 6	29 8	29 1	13 2	15 0	12 1	2 675
Plym.	29 $4\frac{20}{30}$	29 9	29 0	15 7	16 7	13 8	4 500
Norim.	28 77	28 99	28 43				

Air { Ed. dry, V. variable, but generally W, S. W, N. W.
Pl. mean, V. variable.
Nor. V. W, S. W, N. W.

SEPTEMBER.

	Barometer.			Thermometer.			Rain.
Edinb.	29 6	30 2	28 4	12 2	13 8	10 5	1 835
Plym.	29 $6\frac{9}{29}$	30 1	29 0	14 7	15 2	12 9	1 978
Norim.	28 83	29 15	28 27				

Air { Ed. to 14 dry, to 20 v. moiſt, to end dry, V. variable.
Pl. dry, V. variable, but from 9 to 18 E.
Nor. V. W, N. W, from 13 to 16 E.

At Rippon, from the beginning of March, to the middle of September, the weather was very dry, and the mercury at a great height; afterwards the weather was cold, and very rainy, and the mercury ſunk.

OCTOBER.

	Barometer.			Thermometer.			Rain.
Edinb.	29 8	30 4	28 9	10 9	13 7	8 9	1 083
Plym.	29 $7\frac{1}{3}$	30 2	28 8	13 1	14 7	13 8	2 026
Norim.	28 86	29 27	28 32				

Air { Ed. mean, V. W, S. W, N. W.
Pl. dry, V. E, N. E.
Nor. V. N, N. W.

NOVEMBER 1733.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermomer. Med.	Thermomer. G. H.	Thermomer. L. H.	Rain.
Edinb.	29 7	30 3	29 1	10 8	12 7	8 2	0 326
Plym.	29 $7\frac{26}{38}$	30 2	29 1	13 1	13 7	11 6	4 688
Norim.	28 2	29 23	28 9				

Air { Ed. moist, V. W, S. W.
Pl. end moist, V. W.
Nor. V. W, N. W, S. W, sometimes E, N. E.

At Rippon, the weather continued much the same as before till the end of November, when the mercury rose, the spirits in the thermometer fell, and then was a sharp frost for several nights.

DECEMBER.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermomer. Med.	Thermomer. G. H.	Thermomer. L. H.	Rain.
Edinb.	29 5	30 2	28 8	10 7	12 6	8 9	3 629
Plym.	29 $5\frac{26}{31}$	30 1	29 1	12 9	13 8	10 8	4 688
Norim.	28 90	29 16	28 67				

Air { Ed. very moist, V. W, S. W.
Pl. V. S. W.
Nor. wind generally S. W, but frequently E, and N, E.

At Rippon, it was uncommonly warm, even more so than the winter before, and continued till the end of the month, when the mercury sunk low, and there was a good deal of rain.

JANUARY 1734.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermomer. Med.	Thermomer. G. H.	Thermomer. L. H.	Rain.
Edinb.	29 9	30 6	29 2	8 8	11 5	6 2	0 593
Plym.	29 $9\frac{16}{29}$	30 4	29 4	11 2	12 1	9 4	1 480
Norim.	28 91	29 19	28 18				

Air { Ed. moist, V. W, S. W.
Pl. dry, V. N. E.
Nor. V. generally W, S. W, N. W, frequently E, N. E.

At Rippon, there was a little rain the 17th, then three days of serene weather, then three days of rain; afterwards the mercury rose high, the weather became warm and pleasant, and continued so all the remaining part of the winter and spring, till May.

FEBRUARY.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermomer. Med.	Thermomer. G. H.	Thermomer. L. H.	Rain.
Edinb.	29 6	30 3	28 6	10 5	12 2	10 6	0 595
Plym.	29 $6\frac{10}{26}$	30 4	28 5	12 3	12 7	10 8	5 554
Norim.	28 78	29 28	28 15				

Air { Ed. moist, V. W, S. W.
Pl. V. W, N. W.
Nor. V. W, S. W, N. W.

MARCH

MARCH 1734.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 5	29 9	29 1	11 1	12 5	9 5	2 122
Plym.	29 5	30 0	29 0	13 1	13 6	11 8	2 812
Norim.	28 78	28 98	28 45				

Air { Ed. dry, V. variable.
Pl. moift, V. W.
Nor. V. generally W, S. W, N. W.

APRIL.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 8	30 2	29 4	12 2	14 7	9 4	1 006
Plym.	29 $6\frac{9}{28}$	30 0	29 4	13 8	14 7	12 7	2 126
Norim.	28 82	29 12	28 57				

Air { Ed. dry, V. variable.
Pl. middle dry, V. E. to 12 N. W, from 23 to end S. W.
Nor. V. generally W, S. W, N. W.

MAY.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 8	30 1	29 3	12 1	13 9	9 8	3 313
Plym.	29 $4\frac{10}{31}$	29 9	29 0	13 9	14 7	12 5	1 764
Norim.	28 72	29 1	28 51				

Air { Ed. dry, to 26, V. variable, to end moift, V. E.
Pl. V. generally W, fometimes S. E.
Nor. V. W, S. W, N. W.

JUNE.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 8	30 0	29 5	13 8	17 4	10 1	2 210
Plym.	29 $4\frac{11}{29}$	29 7	29 1	15 6	16 5	14 2	3 208
Norim.	28 88	29 2	28 33				

Air { Ed. mean, V. E, N. E, S. E.
Pl. in begin. and end V. N. W, in middle E.
Nor. V. N. W, W, fometimes N, N. E.

In May and June, at Rippon, the weather was moftly much colder than in the two preceding months, and much more variable.

JULY.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 7	30 1	29 3	14 1	16 5	12 6	0 709
Plym.	29 $4\frac{10}{31}$	29 8	28 9	15 5	16 7	14 5	2 982
Norim.	28 77	28 94	28 53				

Air { Ed. in begin. dry, V. var. from 26 to end v. moift, V. E.
Pl. v. moift, V. generally N, in middle S. W.
Nor. V. W, S. W, N. W.
Rip. very changeable.

AUGUST 1734.

	Barometer. Med.	Barometer. G. H.	Barometer. L. H.	Thermometer. Med.	Thermometer. G. H.	Thermometer. L. H.	Rain.
Edinb.	29 6	30 1	28 7	13 3	15 6	12 5	1 285
Plym.	29 $3\frac{27}{31}$	29 8	28 7	15 5	16 7	13 7	4 022
Norim.	28 88	28 94	28 58				

Air { Ed dry, V. variable.
Pl. in begin. dry, V. N. E, after. moiſt, V. S. W.
Nor. V. W, S. W, N. W, ſometimes N. E.

At Rippon, in the beginning of this month the mercury, and ſpirits in the thermometer were high, the ſeaſon dry, warm, and pleaſant, which continued to the middle, when the barometer fell, and there was almoſt daily frequent rain, which continued the remaining part of this, and during the months of September and October.

SEPTEMBER.

Edinb.	29 6	30 0	28 7	12 0	14 4	9 9	1 172
Plym.	29 $6\frac{3}{27}$	30 0	29 0	14 3	14 9	12 2	1 752
Norim.	28 76	29 15	28 57				

Air { Ed. generally dry, V. variable.
Pl. moiſt, V. W.
Nor. V. W, S. W, N. W.

OCTOBER.

Edinb.	29 5	30 2	28 8	10 3	12 4	9 0	1 321
Plym.	29 $5\frac{26}{30}$	30 3	28 8	12 6	13 8	10 6	3 154
Norim.	28 58	28 93	28 12				

Air { Ed. moiſt, V. variable, but gen. W, S. W, N. W.
Pl. moiſt, in begin. V. S. W, from 15 to 23 N. E, after. N. W.
Nor. V. gen. W, S. W, N. W, and freq. N. E, and E.

NOVEMBER.

Edinb.	29 9	30 4	29 3	9 3	11 7	7 7	1 608
Plym.	29 $8\frac{4}{29}$	30 4	28 8	11 5	12 4	9 9	2 068
Norim.	28 87	29 25	28 10				

Air { Ed. moiſt, V. W, S. W.
Pl. dry, to 20, V. betwixt E. and N.
Nor. V. variable.

DECEMBER

DECEMBER 1734.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 0	29 8	28 0	9 1	11 5	7 4	2 322
Plym.	29 $3\frac{9}{31}$	30 0	28 2	11 4	12 5	10 6	6 192
Norim.	28 49	28 98	27 80				

Air { Ed. moiſt, V. W, S. W, N. W.
Pl. moiſt, V. S. W.
Nor. V. E, S. E, N. E.

JANUARY 1735.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 5	30 3	28 2	9 2	11 6	7 6	2 995
Plym.	29 $6\frac{24}{30}$	30 5	28 1	11 2	12 2	9 6	2 526
Norim.	28 51	29 17	28 5				

Air { Ed. very moiſt, V. W, S. W.
Pl. oft. v. moiſt, V. in begin. N, mid. S. W, end. N. E.
Nor. V. W, S. W, N. W, ſometimes E, S. E, N. E.

FEBRUARY.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 0	30 5	28 8	9 0	12 4	7 4	3 507
Plym.	29 $7\frac{10}{25}$	30 5	29 0	11 4	12 1	9 5	1 978
Norim.	28 81	29 18	28 33				

Air { Ed. moiſt, V. W, S. W.
Pl. moiſt, ſomet. dry, V. to 16 N. end S.
Nor. V. W, S. W, N. W.

MARCH.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 3	30 2	29 0	9 9	11 9	8 5	5 375
Plym.	29 $3\frac{29}{30}$	30 0	28 7	11 7	12 4	10 4	2 234
Norim.	28 49	29 2	28 12				

Air { Ed. vaſtly moiſt, V. variable.
Pl. moiſt in begin. V. S. W, from 6 to 17 S. E. after. N. E, N. W.
Nor. V. W, S. W, N. W, frequently N. E.

APRIL.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.	Rain.
Edinb.	29 7	30 1	29 0	11 2	13 5	9 7	1 630
Plym.	29 $5\frac{10}{29}$	29 9	28 8	13 5	13 7	12 1	2 252
Norim.	28 71	29 3	28 36				

Air { Ed. v. moiſt, to 12 V. E to end W, S. W, N. W.
Pl. moiſt, from 2 to 10 V. E. after. variable.
Nor. V. W, S. W, N. W.

MAY 1735.

	Barometer. Med.		G. H.		L. H.		Thermometer. Med.		G. H.		L. H.		Rain.	
Edinb.	29	8	30	2	29	2	12	1	14	7	9	5	0	720
Plym.	29	$6\frac{12}{31}$	30	1	29	1	13	8	14	9	12	1	1	646
Norim.	28	67	28	99	28	30								

Air { Ed. mean, V. inconſtant.
Pl. to 24 V. N. E, N. W, after. S. E.
Nor. V. W, S. W, N. W.

JUNE.

Edinb.	29	7	30	1	29	4	13	5	15	5	11	8
Plym.	29	$5\frac{7}{20}$	29	9	29	1	14	9	15	1	13	7
Norim.	28	75	28	98	28	52						

Air { Ed. dry in begin. and mid. moiſt, V. E, N. E.
Pl. moiſt, V. N. W, ſomet. S. W, from 19 to 22 S. E.
Nor. V. W, S. W, N. W.

No regiſter for rain after May 1735, is publiſhed at Edinburgh.

JULY.

Edinb.	29	7	30	0	29	1	14	2	16	0	12	1
Plym.	29	$4\frac{4}{10}$	29	7	28	9	15	1	15	9	13	7
Norim.	28	76	29	5	28	47						

Air { Ed. dry, freq. moiſt, V. inconſtant.
Pl. very moiſt, V. W, S, and ſomet. E.
Nor. V. S. W, W.

AUGUST.

Edinb.	29	8	30	3	29	2	13	8	17	0	11	5
Plym.	29	6	29	9	29	2	15	5	16	5	13	9
Norim.	28	84	29	17	28	66						

Air { Ed. dry, V. E. to 11, afterwards S. W, W.
Pl. very moiſt, from 2 to 13 V. E.
Norim. V. W, S. W, N. W.

SEPTEMBER.

Edinb.	29	6	30	0	28	7	12	0	14	4	9	9
Plym.	29	$6\frac{7}{10}$	29	9	29	2	14	9	15	7	13	1
Norim.	28	91	29	13	28	58						

Air { Ed. dry, V. W, S. W.
Pl. moiſt, V. N. W. ſometimes S. W. frequently E.
Nor. V. S. W, N. W, frequently E, N. E, S. E.

OCTOBER

OCTOBER 1735.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.
Edinb.	29 9	30 3	29 3	10 1	12 7	8 1
Plym.	29 $6\frac{17}{30}$	30 1	29 1	13 2	14 2	10 6
Norim.	28 82	29 17	28 24			

Air { Ed. moift, 11 to 22 V. E, S. E, afterwards W.
Pl. V. E.
Nor. V. variable.

NOVEMBER.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.
Edinb.	29 5	30 0	28 8	10 5	12 1	7 7
Plym.	29 $4\frac{14}{30}$	30 0	28 4	12 8	13 7	11 5
Norim.	28 81	29 28	28 20			

Air { Ed. moift, V. inconftant.
Pl. moift, V. S.
Nor. V. variable.

DECEMBER.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.
Edinb.	29 7	30 2	29 0	9 6	11 5	7 5
Plym.	29 $6\frac{6}{27}$	30 0	29 0	12 1	13 3	10 4
Norim.	28 67	29 16	28 31			

Air { Ed. very moift, V. variable.
Pl. very moift, V. E. and S. E.
Nor. to 22 variable, to end E.

JANUARY 1736.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.
Edinb.	29 3	29 7	28 9	9 2	11 7	7 3
Plym.	29 $2\frac{27}{30}$	29 8	28 7	11 8	12 7	10 4
Norim.	28 58	29 1	28 9			

Air { Ed. moift, V. S. W, W.
Pl. very moift, V. S.
Nor. V. E. S. E, N. E, fometimes S, S. W, N. W.

FEBRUARY.

	Barometer. Med.	G. H.	L. H.	Thermometer. Med.	G. H.	L. H.
Edinb.	29 4	30 1	29 0	8 5	10 3	6 3
Plym.	29 $3\frac{10}{26}$	30 0	28 5	11 2	11 8	9 3
Norim.	28 28	28 77	27 75			

Air { Ed. moift, V. variable.
Pl. V. N. E, not fo moift as laft month.
Nor. V. variable.

MARCH

MARCH 1735.

	Barometer.			Thermometer.		
	Med.	G. H.	L. H.	Med.	G. H.	L. H.
Edinb.	29 6	30 2	28 9	10 5	14 7	8 8
Plym.	29 4$\frac{11}{31}$	30 0	28 8	12 6	13 6	10 4
Norim.	28 59	29 1	28 24			

Air { Ed. moist, V. E, S. E, N. E.
Pl. dry, V. E.
Nor. V. variable.

APRIL.

Edinb.	29 8	30 3	28 9	11 5	14 5	8 5
Plym.	29 7$\frac{1}{2}$	30 1	29 3	13 8	15 5	11 5
Norim.	28 84	29 13	28 59			

Air { Ed. moist, V. variable.
Pl. V. E, N. W, sometimes N. E.
Nor. V. W, S. W, N. W.

MAY.

Edinb.	29 8	30 3	29 3	11 8	14 9	10 0
Plym.	29 5	29 8	29 1	14 4	16 4	12 4
Norim.	28 65	29 1	28 30			

Air { Ed. dry, V. E.
Pl. V. E. sometimes N. E, N. W.
Nor. V. N. W, S. W.

Of

Of the epidemic diſeaſes at Edinburgh, Rippon, Plymouth, and Norimberg, from May 1731, *to June* 1736.

Theſe may be divided into four claſſes:

I. Diſeaſes of nearly the ſame kind, which were in ſeveral of theſe places about the ſame time.

II. Diſeaſes of nearly the ſame kind, which were at ſeveral places in different years, or different times of the ſame year.

III. Diſeaſes of different kinds, which were at nearly the ſame time in ſeveral places.

IV. Diſeaſes which were at any one of the places mentioned, and not in any of the others.

I. *Diſeaſes of nearly the ſame kind, which were in ſeveral places about the ſame time.*

Small-pox	E. and N. from ſpring 1733, to March 1734. N. and P. in March 1732.
Intermitting fevers	E. P. R. July 1731. E. P. N. May, June 1733, April 1734. E. P. May, June 1734, June 1735. E. N. April, May, July 1732, March 1734. P. N. July 1733. N. R. September 1733.
Slow fever	E. P. Auguſt 1732.
Pleuriſies	E. P. March, April 1732, March 1733, Feb. 1736. E. N. February 1733, July 1735. P. N. April 1733, February 1735.
A cholera	E. R. Auguſt 1731.
Angina	E. P. N. January 1732. E. N. October 1733. P. N. February 1732.
Scarlet fevers	E. N. September, October 1733.
A rheumatiſm	E. P. N. March 1732. E. N. November 1732, February 1733. P. N. March 1732, March 1734 R. N. September 1733, January 1734.
Meaſles	P. N. Auguſt, Septemb. Octob. 1732, Feb. 1733.
Chin-cough	E. P. May 1732, May, July 1734.
Cold, and its effects	E. P. April, December 1732, January 1733. P. N. February 1734.
Catarrhs, and catarrhal fevers	P. R. N. February 1733. E. N. July 1735. P. N. March, April 1733, October 1734. R. N. November 1733.
Colic	P. N. February 1732.

II. *Diſeaſes of nearly the ſame kind, which were at ſeveral places in different years, or different times of the ſame year.*

Small-pox	P. from June to Sept. 1731, Aug. 1732, from Aug. to Dec. 1734, and from Jan. to Sept. 1735. R. from autumn 1732, to January 1733. N. January, May, June 1732.
Intermitting fevers	E. June 1732, Mar. Apr. 1733, from Feb. to May 1735, and that ſummer. P. Aug. 1732, July, September 1734, Octob. 1735. R. June, Auguſt 1731, and end of ſummer 1732. N. October 1732.
Slow fevers	E. from November 1731, to February 1732, Dec. 1732, January, March 1733. P. March 1733, Auguſt, September, October 1734, October, November, December 1735. R. June, July, Auguſt 1731. Jan. Feb. 1733.
Pleuriſies	E. Oct. 1731, that winter, May 1732, June 1735. P. February, March 1735, April, May 1736. R. Sept. Dec. 1733, January, May, June 1734. N. Oct. Nov. 1732, Feb. April 1734, Dec. 1735.
Cholera	E. November 1732, July 1735. P. Sept. Oct. 1731, May 1732, from July to Oct. 1733, Sept. 1734, Auguſt, September 1735. R. end of ſummer 1733, June, July 1734.
Angina	E. Dec. 1731, Nov. 1732, July, Aug. Sept. 1733. P. Dec. 1732, March 1733, from Feb. to Octob. 1734, April 1735, February, April 1736. N. November 1733.
Eryſipelatous fever	E. June, July, September, October, November, December 1735, January, February 1736. P. January 1735.
Rheumatiſm	E. February 1736. P. December 1734. N. Jan. Feb. May, June, Sept. Oct. 1732, Jan. March, May, June, Auguſt, November, December 1733, October 1734, November 1735.
Meaſles	E. from June 1735, to ſpring 1736. P. Auguſt, November 1732, January 1733. N. January, February, July 1732.
Chin-cough	E. March, April 1732, June, Auguſt, September, October 1734, and all the winter. P. Auguſt 1731, February 1732. N. from June to September 1733.
Catarrhs, and catarrhous fevers	E. June 1735, and that winter. N. January, February, March, April, June 1732, May, September, October 1733, Feb. March, April, October, Decemb. 1734, January 1735.

Univerſal

Universal fever of the cold	E. began December 17. 1732, from 25 to middle of January universal, end February 1733. P. began 12 Feb. 1733, universal by 15, end April. R. began Feb. 3. 1733, end 5 or 6 weeks after. N. began Sept. 1732, universal Dec. end Feb. 1733.
Apoplexy ——	P. October 1733, March, November 1734, March, May 1735, January 1736. N. February 1732.
Peripneumony	P. Mar. Ap. 1732, Mar. Ap. Oct. Dec. 1732, Jan. Feb. Mar. 1734, Feb. Mar 1735. Feb. Mar. Ap. May 1736. R. September 1733.
Diseases of the breast ——	R. latter part of summer, autumn, and forepart of winter 1733. N. January, February, March 1733.
Putrid fever —	P. December 1734. R. September 1734.
Erysipelas ——	E. July, August 1731. P. June 1731.
Fever with a diarrhœa —	E. Dec. 1731, Jan. April, May 1732, July 1735. R. December 1733.
Swell. of saliv. glands ——	E. June, July, August 1731. P. November, December 1735, January 1736.
Continued fevers ——	E. Octob. 1734, from Octob. 1735, to Feb. 1736. N. May 1733.
Exanthematous fevers ——	P. August, September 1731, June 1732, September 1734, January, June 1735. R. July 1734.
Diarrhœa ——	E. January 1732. P. May, August 1732, from June to October 1733, August 1735. R. August 1731. N. July 1733.
Scarlet fevers	E. June, July 1733, and that winter. N. December 1735.
Ophthalmy —	E. July, August 1731. P. Mar. April, June 1734, Jan. 1735, April 1736.
Hyst. and hypochond. Sympt.	P. December 1733. R. February 1733.
Colic ——	P. October, Novemb. Decemb. 1731, Jan. 1732, Oct. Nov. Dec. 1733, Jan. Oct. Nov. 1734. N. March, June, November 1732.
Cold, and its effects ——	E. November 1732, spring 1733. P. Jan. Feb. Mar. Sept. Oct. 1732. Sept. Dec. 1733, Jan. Feb. March, April 1734, Jan. Sept. 1735, January February 1736.

III. *Diseases of different kinds, which were nearly at the same time in several places.*

June 1731. —	E. swelling on the face and salivary glands. P. small-pox, erysipelas. R. intermitting fevers.

July 1731.	E. ophthalmy, rheumatiſm, eryſipelatous ſwelling on the face and ſalivary glands. P. ſmall-pox. R. intermitting fevers.
Auguſt.——	E. ophthalmy, rheumatiſm, baſt. ſmall-pox, eryſipelat. ſwelling on the face and ſalivary glands. P. febres miliares rubræ, chin-cough, ſmall-pox. R. diarrhœa, intermitting fevers.
October. —	E. pleuriſy. P. cholera.
January 1732. —	E. pleuriſy, fever with a diarrhœa. P. effects of cold. R. ſmall-pox, meaſles, hæmopt. catarrhs, rheumat.
February. —	E. pleuriſy. P. effects of cold. N. the ſame diſeaſes as laſt month, apoplexy, colic, ſtone, and gout.
March. ——	E. eryſip. œdemat. fever among children, chin-cough. P. effects of cold, peripneumony. N. colic, ſtone, and gout, catarrhous fevers.
April. ——	E. fever with a diarrh. chin-cough, eryſip. œdemat. P. ſmall-pox, peripneumony. N. catarrhs.
May. ——	E. pleuriſy, &c. as laſt month. P. cholera. N. rheumatiſm, ſmall-pox.
June. ——	E. intermitting fevers. P. febres miliares compoſitæ, rubeolæ. N. rheumat. ſmall-pox, colic, catarrhs.
September.	E. ſlow fever. N. rheumatiſm. R. ſmall-pox.
October. —	E. ſlow fevers. N. intermitting fevers, pleuriſy. R. ſmall-pox.
November.	E. aguiſh fits among children. N. pleuriſies, colics, ſtone, and gout. R. ſmall pox.
December.	E. ſlow fevers. P. effects of cold. R. ſmall-pox.
January 1733. —	E. ſlow fever, pleuriſy. P. meaſles. N. diſeaſes of the breaſt, rheumatiſm.
March. ——	E. tertian agues. P. angina, peripneumony. N. diſeaſes of the breaſt, hæmoptoe.
May. ——	E. baſtard ſmall-pox. N. rheumatiſm.
June. ——	E. ſcarlet fevers, and ſore throat. N. chin-cough, gout.

July

July 1733.	E. ſcarlet fevers, with a diarrhœa, anginæ. P. cholera, diarrhœa. R. cholera. N. Small-pox, chin-cough, diarrhœa, intermit. fever.
Auguſt. ——	E. ſcarlet fevers, and ſore throat. P. cholera, diarrhœa. N. rheumatiſm, chin-cough.
September.	P. cholera, diarrhœa. R. pleuriſy, peripneumony. N. catarrhs, chin-cough, gout.
October. —	P. cholera, diarrh. apop. peripneum. rubeolæ, colic. N. catarrhs.
November	E. ſcarlet fevers, and ſore throats. P. rubeolæ, colic. N. anginæ, rheumatiſm.
December.	E. ſcarlet fevers, and ſore throats. P. colic, peripneum. cough, hyſt. and hyp. N. hæmoptoe, gout. R. pleuriſy, fever, with a looſeneſs.
January 1734. —	P. coughs, peripneum. colic. R. inflammation of the inteſtines, pleuriſies. N. ſtone, gout.
February. —	P. peripneumony, anginæ. N. pleuriſy, catarrhs.
March. ——	E. intermitting fevers. P. coughs, ſore throat, ophth. rheumat. peripn. apop.
April. ——	P. opthalm. ſore throats, apop. anginous fever. N. pleuriſy, rheumatiſm.
May. ——	P. anginous fever. R. pleuriſy.
June. ——	E. chin-cough, ophthalm. P. anginous fever. R. pleuriſy.
July — —	P. intermitting fevers, anginous fevers. R. exanthematous fever, cholera. E. chin-cough.
Auguſt. ——	P. anginous fever, ophthal. ſlow fever, ſmall-pox, itch. R. putrid fever.
September.	E. chin-cough, dyſentery. P. angin. fev. ſmall-pox, cholera, ſlow fev. interm. fev.
October. —	E. chin-cough, dyſentery, fever. P. ſmall-pox, colic, ſore throats, ſlow fever, anginous fever, febris miliaris. N. rheumatiſm, gout.
November.	E. chin-cough, dyſentery. P. ſmall-pox, colic, apop.
December.	E. chin-cough, dyſentery. P. ſmall-pox, putrid fevers, rheumatiſm. N. catarrhs, febris petechizans.
January 1735. —	E. chin-cough, dyſentery. P. ſmall-pox, ophthal. coughs, rheumat. feb. miliar. & eryſip. colic. N. feb. catarrh. petechiz. catarrhs, rheumat. ſtone, and gout.

February

4

February 1735. —	E. tertian agues. P. peripneum. ſmall-pox, contagious fever. N. feb. catarr. petech. catarrhous fever.
March. ——	E. tertian agues. P. ſmall-pox, pleuriſy, peripneumony, apop.
April. ——	E. tertian agues, fevers among children. P. ſmall-pox, contagious fever. N. febris catarrh. petechizans.
May. ——	E. tertian agues. P. ſmall-pox, apop. contagious fever.
June. ——	E. meaſles, pleuriſy, catarrhs, eryſip. fever. P. ſmall-pox, feb. miliar. rubra, contagious fever.
July. ——	E. meaſles, chin-cough, cholera, eryſip. fever. P. ſmall-pox, contagious fever, itch.
Auguſt.——	E. meaſles, dyſentery. P. ſmall-pox, cholera, diarrh. contagious fever, itch.
September.	E. meaſles, eryſip. fever. P. ſmall-pox, cholera, diarrh. contag. fev. coughs.
October. —	E. meaſles, dyſentery, fever, eryſip. fever. P. ſlow and inter. fev. an aſthma, which changed into a ſwelling of the legs and abdomen.
November.	E. meaſles, dyſent. fever, effects of cold, eryſip. fev. P. epilep. ſwelling of the ſalivary glands, ſlow fever. N. rheumatiſm, gout.
December.	E. meaſles, dyſent. fever, effects of cold, eryſ. fever. P. nervous putrid fever, coughs. N. hæmoptoe, catarrhous fever, with pleuriſy.
January 1736. —	E. meaſles, fever, effects of cold, eryſip. fever. P. apop. ſwelling of ſalivary glands, coughs.
February.—	E. meaſles, pleuriſies, rheumat. fever, erypſip. fever. P. angina, pleur. peripneum. chilblains of the feet.

IV. *Diſeaſes which happened at any one of the places mentioned, and not at the others.*

Edinburgh.	Baſtard ſmall-pox, Auguſt 1731, May 1733. Dyſenteries, Auguſt 1731, harveſt months 1733, September, October 1734, that winter, October, November, December 1735. Eryſipelas œdematodes, March, April, May 1732. Fever among children, March 1732, April 1735.
Plymouth.	Rubeolæ, June 1732, October, November 1733. Contagious fever, from February to September 1735. Itch, July, Auguſt 1735, January 1736. Epilepſy, November 1735. Aſthma, which changed into a ſwelling of the feet and abdomen, October 1735. Perniones, February, March 1736.
Norimberg.	Hæmoptoe, January, July 1732, March, December 1733, December 1735. Stone and gout, Feb. March, June, Novemb. 1732, March 1733, January 1734, January 1735.
Rippon.——	Inflammation of the inteſtines, January 1734.

MINERAL

MINERAL WATERS.

An account of the virtues and use of the mineral waters near Moffat, by Mr. GEORGE MILLIGEN, *Surgeon at Moffat.* Vol. I. art. 7.

THE mineral waters of Moffat ariſe from two ſprings on the declivity of a hill, and the brow of a precipice, almoſt ſurrounded with high mountains, at the diſtance of a long mile northward from Moffat in Annandale, and thirty-ſix miles ſouth-weſt from Edinburgh. The higher of theſe wells lyes with it's mouth ſouth-eaſt, and is about a foot and an half deep. It's water is uſed for bathing; the ſhallowneſs of the baſon, and the looſeneſs of the earth about it, prevent it's being kept clean enough for drinking. The lower well is ſurrounded with rocks; it's mouth faces the eaſt; the depth of it is four feet and an half. By a moderate computation the two ſprings yield daily about 1360 gallons of water *.

The drinkers of theſe waters think they taſte ſtrongly of ſulphur, and reſemble them to a weak ſolution of liver of ſulphur, or to the waſhings of a gun newly diſcharged. Although the latter ſomewhat comes up to the ſmell, yet it does not to the taſte. The colour of the water, particularly of the upper well, is milky or bluiſh.

The proper ſeaſon for uſing them is between the middle of April and the end of September; but ſome continue their uſe all winter; and, if the rains are moderate, the water is not then inferior to it's ſtrength in ſummer.

* Forty loads, each load containing ſixty four or ſixty eight Scotch pints.

The time of continuing in the bath is from a quarter of an hour to a whole hour or more. Such as bath the whole body usually do it twice or thrice a week in the evening. The best way is to stay in a few minutes at first, and gradually increase the time as the patient finds it agree with him. The bath is made somewhat warmer than tepid; and the patients, when they come out of it, rub and dry their skins, and immediately put on their clothes, without encouraging sweating.

The bathing of the whole body is found inconvenient in inflammations of the face or eyes; and therefore in such cases it is better to bath only the legs.

Such as have ulcers or tumors, commonly every morning and evening put the part affected into a vessel of the water warmed for half an hour, gently rubbing the tumor; through the rest of the day they apply linen rags dipt in the water. When the lips of the ulcer are hard and swollen, the affected part is placed over a vessel of the water boiling, and both covered up, to keep in the steam. In hard tumors, and when the sinews are contracted, many let the water fall from on high upon the part.

The water is commonly drunk between the hours of six and eleven in the morning. They who allow most time, and drink gradually, take the best method. None is drunk after dinner. This water is constantly every day drunk by most patients, especially those who stay only a short time. I am however of opinion, even such would reap more benefit, if they sometimes intermitted a day. Certainly then such as drink the water for any length of time, ought to make longer intermissions in the use of it. It is not easy to ascertain the quantity drunk; most exceed, especially the poorer sort, some of which have been known to drink prodigious quantities without any inconvenience. I never prescribe more than three quarts, or a gallon at most; and this quantity but seldom. Women and men of weak constitutions should not exceed a quart. Children may drink from half a pint

pint to a quart, according to their age and conſtitution; ſometimes, though rarely, three pints; but it is always convenient to begin with a ſmall doſe, and gradually to increaſe it.

Sometimes an emetic or two, and two or three purges, ſhould be given as preparatory medicines. The medicines commonly uſed during the drinking of the waters are Glauber's ſalt and ſal polychreſt, at firſt in large doſes, afterwards in leſſer ones. Of theſe two I prefer the laſt for frequent uſe. Some take ſyrup of buckthorn, others Aix ſulphur, pills compoſed of gamboge, reſin of jallap, and if I miſtake not, ſcammony, are pretty much in uſe at the wells. The exorbitant uſe of purges along with the water I cannot approve of, although it is a general practice here. The meaner ſort take large quantities of ſea-ſalt with the water, others what is falſely called Epſom-ſalt, which is little different from the genuine. With theſe, and ſometimes with Glauber's ſalt, they purge themſelves briſkly, and frequently repeat theſe purges every other day. But this practice is certainly unjuſtifiable, and I have frequently ſeen bad conſequences from it.

From the ſtricteſt obſervations, I find this water to be only an alterant and diuretic. It is true, it generally opens the belly, and with ſome it purges. But this is owing to drinking too large quantities of it, or to a very lax ſtate of the ſtomach and inteſtines, or to ſome ſingularity of the conſtitution.

If the water paſſes freely by urine, and keeps the belly open, medicines are uſeleſs. But till this is effected both cathartics and diuretics ſhould be given. If the water ſtay long, bleeding is neceſſary, which will facilitate the operation of diuretics, and prevent feveriſh fits. An infuſion of aromatic and bitter ſubſtances in wine helps weak ſtomachs, and prevents that heavineſs and inclination to ſleep, which ſome complain of, after drinking the water. Hyſteric women and men with weak ſtomachs, ſinking ſpi-

rits, &c. receive benefit from ſalt of amber, either by itſelf, or mixed with other diuretics.

Too ſtrict a regimen need not to be obſerved. But milk, ſalted meat, eggs and fiſh, are improper food. Riding and moderate exerciſe aſſiſt the water. Upon dropping the uſe of the waters, there is no neceſſity of taking any medicines.

This water is ſecond perhaps to few medicines in diſorders of the ſtomach and bowels. In bilious and nephritic colics it has done good ſervice, and cured nervous and hyſteric colics, though of long ſtanding. Many indeed miſs relief from this water, which is entirely owing to their drinking too large quantities of it, and too often uſing purging ſalts. For my part, when I find the water purge, I give laudanum, and rarely make uſe of purges in theſe diſorders, unleſs in caſes of neceſſity. We have daily inſtances of the efficacy of this water in ſtrengthening weak ſtomachs, and recovering an appetite loſt by debaucheries and indulging in ſpirituous liquors. In diſorders of the kidneys and urinary paſſages, this water is proper; for it frequently carries off ſand, curing iſchuries, and if I was not miſtaken in the diagnoſtic, ulcerated kidneys. It is probable, that emollient and diuretic decoctions drunk ſome days before and after taking the water, would be of ſervice in diſorders from the gravel. Some have uſed this water for the gout; but I cannot ſay that I have known it do any great matters in it. But we have inſtances of it's having done ſervice in palſies. Two gentlemen, who were troubled with a numbneſs, and almoſt total want of feeling, with a great feebleneſs of all their limbs, eſpecially the legs, after being well purged, drank the waters with ſalt of amber, but not every day, took a glaſs of bitters daily, and bathed thrice a week, uſing the water warm in the evening, and cold next morning; at which time they continued only a few minutes in it. One of theſe gentlemen was perfectly recovered, and the other became much better. But I look upon this water rather as a preventer of theſe terrible ma-

 ladies,

ladies, by helping cachexies, ſweetning the juices, *&c.* than as a powerful medicine when they are formed. Many have reduced an over-grown habit of body by it, and carried off ſpontaneous laſſitudes. In obſtructions of the menſes, half baths are proper; but the drinking of the water is of no further ſervice in theſe diſorders, than as it mends the ſtomach, and betters the conſtitution. In hyſteric and melancholy complaints, it does good, and has cured barenneſs, even where there were very little hopes. In all female weakneſſes and diſorders it has been found uſeful. It is alſo a good remedy in old gleets, either natural, or cauſed by venereal diſorders; only care ſhould be taken, that the venereal taint is firſt removed; otherwiſe the water will throw the diſtemper into the blood.

Such as are troubled with rheumatic pains, are relieved by drinking of, and bathing in, this water: nor do ſcorbutic patients find leſs advantage from uſing it both ways. Great cures have been brought about even when the diſtemper has been at it's height; but, however, the water is moſt to be depended upon in the beginning of the diſeaſe; for when the fibres are relaxed, it has proved rather detrimental than of ſervice. In cutaneous eruptions it is a good medicine: the itch, and St. Anthony's fire, which are frequent here, and return to many in the ſpring and autumn, are cured by it, uſed both outwardly and inwardly.

In ſcrophulous diſorders I have never known this mineral water to fail, if the conſtitution was not quite decay'd, or ſome particular diſorders did not forbid it's uſe, and a ſufficient time, a few ſeaſons only, were allowed it. Before the uſe of this water, the ſcrophulous patient ought to be vomited, and well purged; nor will ſome doſes of mercurius dulcis, in the intervals of purging, be amiſs. Many indeed of theſe patients cannot ſafely take mercury, nor ought it to be long inſiſted on with any, but a few doſes have done ſervice. I give ſome doſes of rhubarb by itſelf, or with two or three grains of calomel, on the

 days

days when the drinking of the water is omitted. In theſe intervals I likewiſe order antiſcorbutic, and, at other ſuch times, emollient and diuretic infuſions and decoctions; but the water itſelf is moſtly to be relied on, and the cure is chiefly owing to the drinking of it, though the external application is of ſervice in cleaning the ſores, eaſing the pain, and healing the ulcer. Where the ulcers are foul and fungous, I uſe eſcharotic powders by themſelves, or mixt with ſome ointment; and when the lips of the ulcers are inflamed, and the parts round them ſwelled and hard, I uſe emollient applications, the beſt of which is that compoſed of two parts of galbanum, and one part of melilot plaiſter. The ſcrophulous, after dropping the uſe of the water, ſhould recommence purging and mercurial doſes for ſome time, and perſiſt in the uſe of emollient and diuretic medicines, and among theſe chiefly the millepedes.

Experiments on the medicinal waters of Moffat, by ANDREW PLUMMER, *M. D. Fellow of the Royal College of Phyſicians, and Profeſſor of Medicine in the Univerſity of Edinburgh.* Vol. 1. art. 8.

THE mineral water weighed at the fountain was found lighter than the water of a rivulet near the well: the ſpecific gravity of the firſt was to the latter as 838 to 840. The mineral water, brought to Edinburgh in bottles well corked and waxed, appeared as clear and limpid as ſpring water, and had at firſt opening the bottles a ſtrong ſulphureous ſmell, and taſted as ſtrong as at the well, but next day, the bottle being half empty, the water had quite loſt its diſtinguiſhing ſmell and taſte.

This water gave no marks of a chalybeat nature with galls, nor of acidity with tincture of roſes or ſyrup of violets, neither did it produce any efferveſcence with oil of tartar per deliquium or ſpirit of ſal ammo-

ammoniac, only when the firſt was dropt into the water, there appeared a faint blue cloud ſuſpended in it. Acid liquors dropt into the water made no ſenſible effervеſcence, only the mixture with ſpirit of nitre ſmoked a little, and ſome bubbles of air roſe from the bottom. Theſe phænomena diſcover a ſubtile volatile ſulphur, but in ſmall quantity, ſeeing the water expoſed to the air ſoon loſes its remarkable ſmell and taſte, and ſeeing acid liquors cannot ſeparate or precipitate it. I made many attempts to fix this ſulphur and render it conſpicuous, but without ſucceſs. A few grains of vitriolum ſaturni made with aqua fortis ſimplex turned the water of a reddiſh colour: after ſtanding ſome minutes, the water grew more pellucid, and the red particles uniting fell moſtly to the bottom, and ſome ſmall flakes ſwam on the ſurface. This matter reſembled the ſulphur auratum antimonii, and made me imagine that it was the ſulphur of the water fixed; but on a red hot iron plate it only melted and ſmoked, but did not flame; when the iron was cold I found upon it a thin ſcurf of lead; ſome of this powder digeſted with oil of tartar in a ſand-heat acquired no tincture, as it would have done from a ſulphureous ſubſtance. Six gallons of the water diſtilled with a gentle heat in glaſs veſſels, the liquor which came over was limpid, had no ſmell or taſte, but a little empyreuma: what remained had no ſmell, but taſted ſaltiſh. When three fourths were brought over, there appeared a good quantity of a muddy ſediment, which I ſeparated, and carried on the evaporation in a long wide-mouthed glaſs. When the water was reduced to ſomewhat leſs than a quart, it grew thick and bubbled. When all was cold, I found at the bottom a dirty ſalt mixed with earth. The ſaline particles were ſo ſmall that their figure could not be diſtinguiſhed, but the liquor had a muriatic taſte. Upon cryſtallizing the remaining liquor (except two ounces) there were obtained four drams and two ſcruples of a brown ſalt. This ſalt diſſolved in ſome of the diſtilled waters, filtred and recryſtal-

 lized,

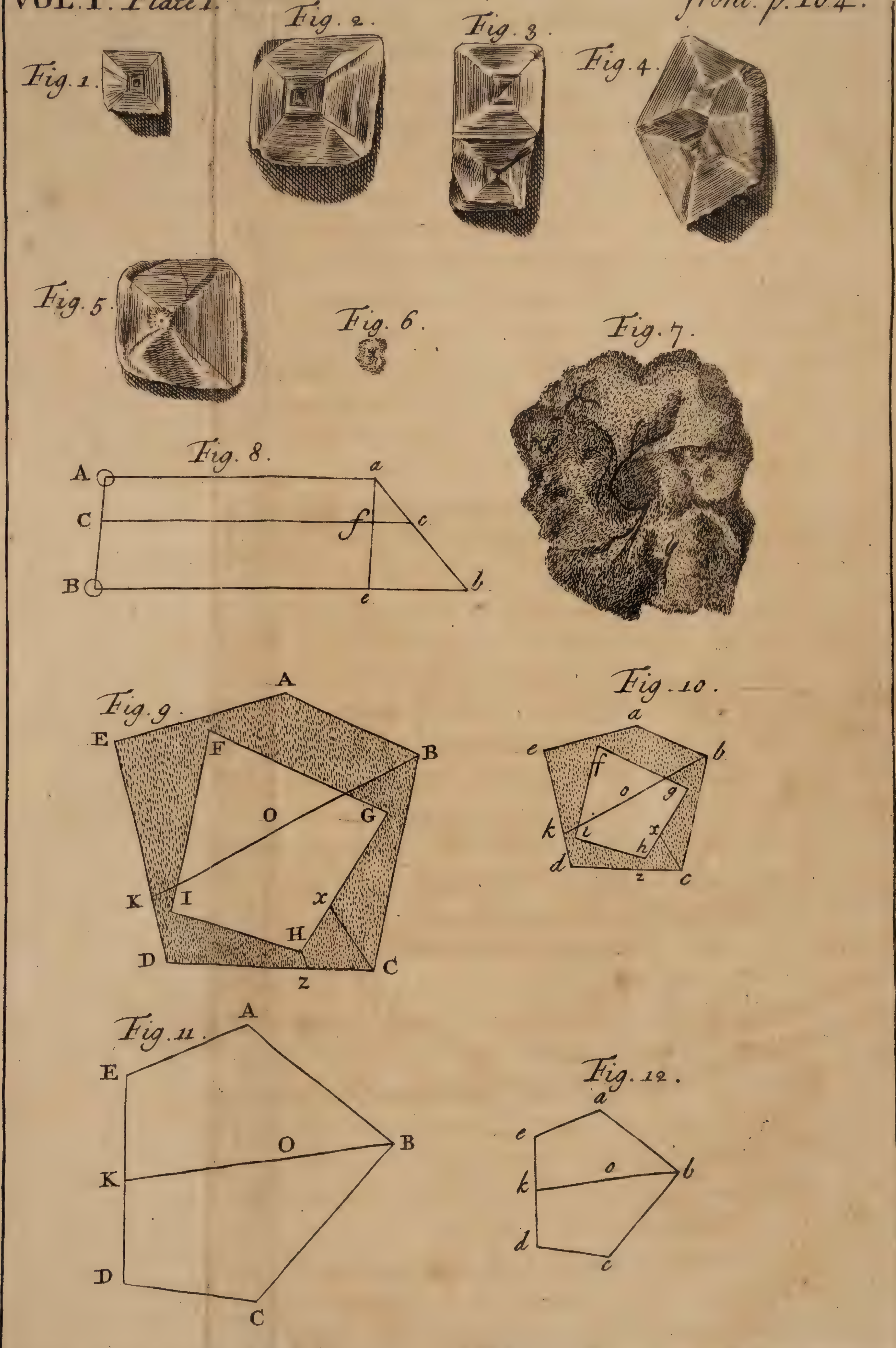
lized, appeared in beautiful cryſtals, of an uncommon figure, but almoſt exactly alike, ſome of which are repreſented in their natural bigneſs on plate I. where Fig. 1. ſhews a ſmall cryſtal, but very compleat and regular. Fig. 2. repreſents one of the largeſt, ſomewhat rugged at the corners. Fig. 5. is the reverſe of the former. Fig. 3. ſhews two joined by one ſide. Fig. 4. repreſents two irregularly blended. Beſides the cryſtals repreſented in the plate there were others of a cubical ſhape, both ſorts had the taſte of ſea ſalt. Two drams of the ſalt heated red hot in an iron ladle, crackled, but neither melted nor flamed, and loſt only eighteen grains in an hour's calcination, which makes it evident that it is neither nitre nor ſal ammoniac. This decrepitated ſalt with four ſcruples which had not been calcined, mixt with a dram of oil of vitriol emitted copious white fumes. The mixture being diſtilled, yielded two drams of a ſmoking ſpirit like Glauber's ſpirit of ſalt.

Some drops of this ſpirit precipitated a ſolution of ſilver, as likewiſe did ſome of the ſalt and ſome of the water when evaporated to $\frac{1}{36}$ part. From all which it is plain, that this water is impregnated with common ſalt, and although the cryſtals above differ from the cryſtals of common ſalt, yet upon a ſlow evaporation of a ſolution of ſea ſalt, I have obtained cryſtals not unlike thoſe of the Moffat water. Into ſome of the water when evaporated to $\frac{1}{36}$ part ſome oil of tartar per deliquium being dropt, produced a milky colour and coagulation but no efferveſcence. Upon ſtanding, the upper part of the liquor turned clear, and of a whey colour. The ſame happened with ſpirit of ſal ammoniac made with fixt alkali. Spirit of vitriol dropt into theſe mixtures after the efferveſcence diſſolved the coagulation and rendered the liquor pellucid, but dropt into the brine by itſelf cauſed no efferveſcence or change.

The difference between theſe phænomena and thoſe formerly obſerved in the freſh water upon mixing the ſame liquor is remarkable, for acid ſpirits turned the

freſh

VOL. I. Plate I. front. p. 104.



fresh water milky, becauſe then the water was impregnated with its ſulphur, which the acid coagulated, ſo as to change the colour of the water; but alkaline liquors produced little change in the freſh water, becauſe a ſmall quantity of ſalt was diſperſed through a great bulk of water. On the other hand, when the ſulphur was carried off by heat, and the ſalt gathered into narrower bounds, then the acids had no effect, but the alkalies a conſiderable one, by joining themſelves to the particles of ſalt and connecting them.

The ſediment at firſt ſeparated, when dry, weighed twenty five grains, it was of a ſandy colour, and taſted a little ſaline. This powder made red hot in an iron ſpoon over the fire ſmoked a little, turned black, afterwards red, and at laſt white; it weighed ſeventeen grains and felt like chalk. The earth ſeparated from the ſolution of the ſalt by filtration weighed fifteen grains, it had no ſaltneſs, but was more gritty than the former. When calcined it ſmoked but little, ſcarce changed its colour, and when cold weighed ten grains.

The ſtones dug from the bottom of the upper well at Moffat, are made up partly of a cryſtalline ſpar cut into many poliſhed ſurfaces, partly of a ſhining ſubſtance of a gold colour, but moſtly of a leadiſh coloured ore.

From theſe ſtones no ſulphur could be obtained by ſublimation; but two ounces of them in powder digeſted with a ſolution of ſalt of tartar gave a very red tincture, from which by pouring in ſpirit of vitriol, I got a powder of a citron colour, weighing ſeventeen grains, which put upon a red hot iron, gave a blue flame and ſulphureous ſmell.

Two ounces of the ſame mineral, mixt with an equal quantity of tartar and nitre, after half an hour's fuſion, were thrown into a hollow cone, on which, there appeared many ſhining particles diſperſed through the maſs, like very foul antimony. The whole was again reduced to powder, and water poured on it, which acquired a fetid and ſulphureous ſmell, and a taſte

taſte reſembling the freſh mineral water, but ſtronger. This water with ſpirit of vitriol, afforded a ſulphur like the former. The metallic matter freed from the ſalts by waſhing, was melted with nitre and tartar, and I found at the apex of the cone a piece of very pure copper weighing forty two grains, which anſwered all the characters of that metal*.

From all this I may conclude, that the principles contained in this water are a very ſubtile and volatile ſnlphur, at leaſt ſome conſtituent parts of ſulphur, ſome particles of copper and ſal gem, or common ſalt.

An enquiry into the natural hiſtory and medical uſes of ſeveral mineral ſteel waters; by Dr. ALEXANDER THOMSON, *Phyſician at Montroſe.* Vol. 2. art. 6.

STEEL ſpaws are very numerous in the country about Montroſe. The ſoils, out of which they ariſe, are various. That near Aberbrothoc is in a gravelly clay, below which there is a ſtratum of pebble ſtones intermingled with ſand, and under it another of ſand and gravel mixed. The well ariſes at the lower part of a den, about fifty paces diſtance from a rivulet. About three or four hundred paces above the well there is a ſpring of common water, and the ſide of the rivulet oppoſite to the well is bounded by a gravelly rock, betwixt the layers whereof ouzes clear water dropping over ſtrata of ſmooth ſhining clay. At the top of the rock there is a ſmall well of good water.. The water which ouzes from the ſide of the rock, being evaporated, leaves nothing but a grey powder like clay. There are no more rocks within a conſiderable diſtance from the well.

* A more exact eſſay of this mineral might be made by gently roaſting it with a gradual fire, in a flat diſh, expoſed to the free action of the air, then mixing it with a ſmall quantity of bright iron filings, and an equal quantity of the whole of the black flux compoſed of two parts of tartar and one of nitre.

The

The ſoil of moſt of the wells which I have examined is like this, and generally a rivulet runs near them through a bed of flint ſtones and ſand. This is the caſe with the well of Kincardin, which is eſteemed next to that of Aberbrothoc; and I am informed that the ſoil of the well at Peterhead is the ſame, without any rocks in its neighbourhood, except the ſea rocks, to which it is ſo near, that it is overflowed by high tides. There are only three ſpaws hereabouts, the ſoil whereof varies from that above. One of them is in Glendy, beyond the famed cairn on the Grampians. The ſoil of this is bog, with moſs ground round it, and no rock is near it. The ſpring bubbles up like a pot boiling, and appears of the colour of oker, with which one's ſhoes are coloured by walking on the moſs near the well. I have ſeen another ſituated in the like ſoil in Lentretham, near the mouth of Gleniſla, but it does not bubble up like this. The only ſpaw within my knowledge which hath any thing of rock in its neighbourhood is that near Cortachie, ſituated at the foot of a hill, near the river South-Eſk. At the diſtance of forty paces are many rocky ſtones which ſparkle like marcaſites; pearls are fiſhed for in the neighbouring river.

I could find no difference in the ſpecific gravity of theſe mineral waters from that of fountain water. The fixed mineral contents of the ſteel waters of Aberbrothoc and Peterhead may be collected by ſuffering them to ſtand in open bottles for ſome days; for then their contents will be precipitated, and the water being poured off will let fall the remains of the mineral by pouring common water into it. The precipitation may be haſtened by proper aſtringents. The mineral ſubſtances thus collected are to be dried in any gentle heat. In this manner they will be got more entire than by boiling, which may force off the more volatile ſubſtances.

Two gallons of Aberbrothoc water being evaporated at the well, no pellicle appeared; the remaining powder weighed, as near as I could judge, between fifteen

fifteen and twenty grains; which, put into a hot iron ladle, ſparkled as the fine filings of iron uſe to do.

I am ſatisfied with Monſ. du Clos, that it is not eaſy to determine what ſalts theſe waters contain, or whether all are impregnated with the ſame kinds of ſalts: he could find neither alum nor vitriol in any of the French wells; only in one he found ſome reſemblance of the latter: all the other wells gave a ſalt, anſwering to a compoſition of nitre and ſea ſalt mixed in various proportions; which probably is the natural ſalt of the earth diſcovered by Monſ. Tournefort*, reſembling in moſt trials the nitrum of the Levant, being neither acid nor alkali, but approaching moſt to the latter.

Having affuſed the ſame quantity of Peterhead and Aberbrothoc waters on like quantities of gall, the former ſtruck a deep purple colour, while the latter became only dilutely red. I added gradually double the quantity of common water to the tinctured Peterhead water, before it became preciſely like to the colour of the Aberbrothoc water; whereby we may ſee, that the mineral is two thirds ſtronger in the former than in the latter. The water of Glendy came neareſt to that of Peterhead in its deep tincture; next to it was the water of Kincardin: moſt of the other ſpaws gave a tincture much like that of Aberbrothoc.

The infuſion of the ſleeks † gathered from the ſtones of the well of Aberbrothoc, made with water or vinegar, ſtruck a deep coloured tincture when galls were mixed with it.

Rectified ſpirit of wine makes no change on the ſteel waters; but when the gall is afterwards added, the tincture is higher than when no ſpirit is uſed. Common ſpirit of wine turns the water of a fine light violet colour, and when the gall is added the tincture becomes more duſky than by the gall alone.

* Preface to his hiſtory of plants in the neighbourhood of Paris.

† A ſort of ſhining clay.

There

There is ſomething in our ſteel ſpaws ſo very volatile as to diſappear upon the leaſt acceſs of air*, after they are taken up from the well, eſpecially in hot weather, for in ſuch circumſtances the waters do not anſwer the uſual trials made with them; and I have obſerved the ſame alteration in the Liege and Pyrmont ſpaws, which ſeem to be only diſtinguiſhed from ours by the vinous flavour peculiar to them.

As to the medical uſes of our ſprings, they evacuate moſtly by urine, and only in a lax texture of the bowels. I have found them, eſpecially that of Aberbrothoc, good in nephritic diſeaſes, ſcouring off gravel, and ſometimes puſhing a ſtone down. They are beneficial in the ſcurvy, eſpecially when the humours are aceſcent, and in all diſeaſes of the ſtomach owing to an acid. In general, they are ſerviceable, and may be uſed freely in all diſpoſitions occaſioned by a morbid acid; but where the alkaline or bilious diſpoſition prevails, they are to be ſparingly, if at all taken: and, as obſervation hath ſhewn, that there are ſuch oppoſite cauſes of diſeaſes, ſo the uſual trials diſcover an alkali in theſe waters; and hence the general name of acidulæ is an improper one.

In too great a relaxation of the ſolids, eſpecially of the ſtomach and chylopoietic organs, the Peterhead water has by far the preeminence, as the Aberbrothoc water has in lowneſs of ſpirits and other nervous diſorders; in which caſes I have obſerved the Kincardin of ſervice.

A burgher of Montroſe, about thirty years of age, returned from a voyage, ſcorbutic, emaciated, enervated in all the digeſtive powers, low ſpirited, and ſo feeble, that he could not walk, or ſit on horſeback, but with difficulty, after drinking Aberbrothoc water at the fountain a few days, he in great meaſure recovered his ſtrength and ſpirits.

* It does not appear clear from experiments that the alteration which ſpaw waters undergo by being expoſed to the air, is owing to the diſſipation of any volatile part.

A

A gentleman ſixty years of age, of a vigorous conſtitution, which he impaired at times by good fellowſhip, grew unable to walk without ſupports, recovered his ſtrength by the means of this water in a few days, and received the ſame benefit a great many times from the ſame means.

A lady in a declining age, having contracted an infirm ſtate of health, attended with a conſiderable depreſſion of ſpirits upon every little accident, and having made uſe of ſeveral medicines to little or no purpoſe, drank the Aberbrothoc water at her own houſe in the ſpring for a month with ſome intervals, and thereby recovered both health and ſpirits. The water, which was always taken up at night, kept freſh two or three days, and afterwards was renewed.

A gentleman from an aguiſh indiſpoſition, fell into a depreſſion of ſpirits, which he recovered in good meaſure by a low diet. When the diſorder returns, as it often does, he finds relief from the Liege and Pyrmont ſpaws, and from the Aberbrothoc water in its ſeaſon. He prefers the laſt, though it is brought farther, and longer kept than the former.

Theſe two caſes ſhew, that notwithſtanding the virtue of the water is very liable to fly off, yet it may be drunk to good effect, at a great diſtance from the well, if it be taken up at a right time.

The beſt ſeaſon of drinking theſe waters is in April and May, after the rains have fallen, and before the heat of ſummer comes on, and in the month of Auguſt to the middle of September, before the rains begin; at both which ſeaſons they generally taſte moſt of the mineral. In the hotteſt weathers theſe waters are moſt faint, except after a moderate ſhower of rain which recovers the taſte, though conſiderable rains weaken it. But however the badneſs of the accommodation of the place has fixed the ſeaſon to the two intermediate ſummer months, when walking about in the open air is more agreeable. But I prefer the water rather at home in the proper ſeaſon, and direct it to be warmed if it proves too cold for the ſtomach.

Great

Great numbers drink theſe waters without obſerving any regimen, or having any directions from a phyſician; nor is there any neceſſity of a preparative except in a very remarkable foulneſs of the juices; nor do I allow of purges during the uſe of the water, unleſs the patient bathes in it. The medicine I ordinarily give is cryſtals of tartar, ſometimes with ſtewed prunes to promote the natural evacuation.

Many remarkable accidents have happened from the frequent cuſtom of drinking theſe waters in too large quantities, ſo that there is juſt reaſon to doubt, whether the abuſe of theſe waters does not more harm than the right uſe does good. My general rule is not to exceed three pints drunk leiſurely till the evacuation by urine begins, chewing carraways or any aromatic which is agreeable to the ſtomach, and walking in the intervals of drinking, and after it is over, till moderately fatigued.

As to the choice of theſe waters, thoſe which are moſt impregnated with the mineral drunk in ſmall quantities, are moſt proper when the ſprings of the fibrous ſyſtem are to be ſcrewed up: but if our deſign principally is to waſh the inwards, the weaker kinds are to be choſen, and in larger quantities.

With regard to exerciſe, it is to be excepted to in great relaxations of the ſtomach, when it is ſo diſordered as frequently to throw up its contents, which often happens to women. Such are to feed abed, and lie till the firſt digeſtion is accompliſhed. A gentlewoman, looked upon as quite loſt in a diſorder of this kind, was carried from Montroſe to Peterhead, where ſhe drank the water abed, laying herſelf to ſleep after each draught, by which means ſhe retained it, and returned perfectly recovered, and remained ſo.

The Aberbrothoc water is in the greateſt eſteem in this country, moſt cures having been made by it, which whether owing to the ſuperior virtue of its ſulphur, which I begin to diſcover more conſpicuous in it than in others, or to the greater number of patients

tients repairing to it, I ſhall not determine; for I, in ordinary caſes, recommended the neareſt ſpaw, eſpecially that of Kincardin, or that on the river Eſk in the ſkirts of the Grampians. The firſt comes the neareſt to the Aberbrothoc waters.

A girl in bad caſe of the nerves, as nature was framing her into the condition of her ſex; and her brother, a boy of ten years of age, enervated to almoſt a cripple all over his body, are now recovered by drinking and bathing in theſe waters two ſeaſons.

Inquiry into the mineral principles of Montroſe water, by ALEXANDER THOMPSON, *M. D. at Montroſe.* Vol. 3. art. 8.

THE Montroſe well is ſituated in the richer ſort of our ſoil; the upper ſtratum being of a blackiſh colour; the lower, to about three feet depth from the ſurface, conſiſts of layers interchanged perpendicularly, one of ſoft clay, the other of ſand, ſoft, and, as it were, fattiſh to the touch; through which laſt, at about the above depth, the ſprings drill out horizontal to the ſurface in ſeveral parts.

The water when new taken up, is of a whitiſh colour; the taſte ſoft, and faintly diſcovers the mineral quality. The weight of this water, compared with two ſteel ſpaws, and a fine ſpring water, appeared not to differ from any of them.

The trials commonly made with ſteel waters did not anſwer with this, and I ſuſpected its purgative quality might be owing to its being drunk muddy. But ſoon after, I perceived it to be of a different nature from the ſteel ſprings, from the various colours which I obſerved on the ſurface of it, after it had been mingled with galls, roſebuds, and green tea, and which made me conclude that there was ſomething ſulphureous in the water.

I dropt ſome oil of tartar per deliquium into a glaſs of the water, and preſently a light white cloud formed

formed at the bottom, like that which appears in urine about the time of a favourable crisis. As this appearance in urine gives, as I imagine, plain notice of the morbid sulphureous parts of the blood perfectly concocted and washed off, the analogy seemed to me natural betwixt the two appearances in the urine and in the mineral water.

To try this farther, I made a soluble sulphur, with four parts sulphur to a fifth salt of tartar. After this had become moist by imbibing the air, I diluted it with water, till the solution became of the colour of our water. Oil of tartar dropped into this gave the same kind of cloud, so that the one could scarce be distinguished from the other.

From these experiments I was led to believe that these clouds were a lac of sulphur; but for further satisfaction, I tried the water with alum, it quickly formed a white coagulum, which, on dropping in some oil of tartar, subsided. The residuum separated from the water and dried by the sun, was a concrete mass of a soft taste with nothing saltish in it.

For trial whether sulphurs were universally affected by an alkaline salt in the same manner, I dropped some oil of tartar into common spirit of wine, and presently a cloud was formed towards the bottom of the glass, of a higher colour than the liquid above. With oil of olives it succeeded in the same manner.

The next trials were with alkaline and acid spirits.

Spirit of hartshorn caused a cloud of a yellow colour, which vanished in half an hour, and left the water of a more milky complexion than it was at first.

Spirit of nitre turned the water into a fine light blue colour.

Spirit of vitriol changed it into a faint purple.

Upon dropping in a solution of sublimate, a cloud began to form, but formed gradually.

Solution of sublimate, with solution of sulphur with fixed alkali, made presently a coagulum.

By these experiments it appears, that the alkali prevails in the salt of the water. But this can determine no-

thing concerning the ſpecies of the ſalt, ſince the moſt reputed acids prove no leſs alkaline upon trials.

But what is moſt to the preſent purpoſe is, that the ſtrongeſt alkalies and ſtrongeſt acids both agree in forming an equable cloud in the water. The coagulum formed in the ſolution of ſulphur with fixt alkali, is owing to the mercury being more freely diſengaged of it's menſtruum by a ſtronger alkali than the ſalt of our well, and thereby precipitated in greater quantity.

The analogy and difference between the Scarborough water and ours, appeared on the following trials.

Oil of Tartar poured into Scarborough water, formed immediately a thick milky equable cloud.

Solution of ſublimate corroſive, made inſtantly a thin white cloud.

Solution of ſublimate gives with our water ſuch a cloud as oil of tartar does with the Scarborough water.

Solution of ſalt of tartar forms the ſame cloud in both waters, but in the Scarborough more immediately. A lac of the Scarborough water anſwers to the ſame ſenſible qualities as that made of ours.

Powder of galls turned both waters into a duſky green.

Theſe, I think, are as near reſemblances as are to be found betwixt any two mineral waters. The variety that appears may be owing to ſome difference in the proportion of the ſalts.

The following trials were made with different ſalts, ſingle and combined, in order to find out the contents of our water.

Oil of tartar makes no change of conſequence in ſolution of nitre, but formed a cloud in a ſolution of nitre and ſea ſalt mixed.

Solution of ſublimate corroſive, made no change in the above ſolutions mixed, but with ſolution of nitre alone, after ſome time formed a cloud like that by oil of tartar on ſolution of ſulphur with fixed alkali, and on our water.

A mix-

A mixture of ſolutions of alum, nitre, and ſea ſalt turned white. Oil of tartar gave an appearance of a cloud, but not an equable one. Solution of ſublimate turned the above ſolutions bluiſh without any farther alteration.

Oil of tartar made no change in ſolution of ſea ſalt for ſome time, but at length fell down as it were muddy to the bottom, with a faint, but an unequal appearance of a cloud.

Oil of tartar made immediately a white precipitate in ſea water, then a thick cloud, which afterwards precipitated in an equable one. Spirit of hartſhorn formed quickly an equable cloud on the top of ſome ſea water, reſembling that made by the ſame ſpirit in our water. But I could obſerve nothing of that whiteneſs or curdling which Dr. Short obſerved to be made by this ſpirit and oil of tartar in ſea water. Some of this ſpirit made no change in ſpring water, by which I perceived a further improvement of the above analogy, which I ſhall now ſtate.

It appears from the trials above, that no ſalts come up to any analogy with our water, and that of Scarborough, except nitre and ſea ſalt; but eſpecially that of the ſea without evaporation: yet neither of them, either ſingly or when combined, agree with them in the trials, both with acids and alkalies; whereby it appears, that the ſpecific qualities of theſe waters are not confined to either or both theſe ſalts, or the earths they lodge in. On the other hand, theſe ſalts being ſulphureous correſpond to a further ſulphureous principle in theſe waters, anſwering more perfectly the analogy above ſtated with ſulphur itſelf. The inflammability of nitre proves it's ſulphureous kind and the difference of the ſalt of ſea water before the evaporation from prepared ſalt, appears above from the different effects of fixed alkali on ſea water, and on ſolution of ſea ſalt. This difference is owing to the ſulphur of the ſalt in the water before exhalation, which is not in the ſalt when prepared.

The laſt thing I have to obſerve on this part of the analogy, is, that as oil of tartar makes a cloud in ſolution of nitre and ſea ſalt, and ſolution of ſublimate in ſolution of nitre alone, I tried to make a lac of both in the manner I did by our well, but had only a wet coagulum without any lac falling equably to the bottom; ſo that nothing but what is ſulphureous, or rather ſulphur itſelf, can, it ſeems, give a lac. An accident confirmed this. A ſolution of alum, nitre and ſea ſalt, into which ſome oil of tartar had been dropp'd, precipitated from ſoap water a lac, leaving the water clear above.

Thus far analogy hath led me. Other ways of enquiry into the principles of mineral waters have not ſo well ſucceeded. Nothing hath been found to come over the ſtill by which we could gain any information.

Chemical mixtures to diſcover contraries by contraries have as little reached the compoſition of natural bodies, the mineral eſpecially. All the foſſil ſalts, the ſuppoſed contents of mineral waters, are accounted acids, and appear ſo to the taſte; yet all of them have been found by monſieur Tournefort to go leſs or more on the alkaline nature: ſo the moſt alkaline of earths, burnt limeſtone, wants not it's own acid.

Upon the whole, theſe names teach us but little of the nature of things; whereas the way of analogy betwixt things known and things ſought for, rightly purſued, ſeems the moſt univerſal method of enquiry into natural compoſitions; and if it leads us not up to demonſtration, it comes neareſt to truth of all others. The learned have contented themſelves with this method in their enquiries into ſteel ſprings. Galls with a ſolution of iron give a purple colour; therefore whatever water with galls ſtrikes ſuch a colour, is concluded to participate of iron. Why may not the ſame way of reaſoning on all mineral ſprings be allowed?

To know the more adequately what ſpecies of ſalt or ſalts our waters and that of Scarborough contained, I made all the trials of the abovementioned author, and

and found them to agree the neareſt to nitre and ſea ſalt; and by comparing Mr. Tournefort's obſervations on the natrum of the Levant with thoſe on nitre and ſea ſalt, and all three with his enquiry concerning the natural ſalt of earth, it appears that the natrum and natural ſalt anſwer almoſt the ſame trials, and that the nitre and ſea ſalt anſwer to both more than any other ſalt; that is, nitre and ſea ſalt appear to make up the greateſt part of this univerſal ſalt: and if to this we add his diſcoveries concerning the natural ſalt of earth, we may hence probably have a more natural account of ſuch mineral waters formed by water falling on beds of ſuch mineral ſubſtances.

I thought it beſt to finiſh this enquiry into our water by analogy, before I entered on an examination of it's contents got by evaporation.

I boiled leiſurely ſome pounds of the ſand in four quarts of the mineral water to one half, then filtred and ſlowly evaporated it, but no pellicle appeared. The reſidue was a black ſubſtance, ſparkling and leafy, of a fattiſh taſte, and weighed about five grains. This gave to two drams of ſpirit of wine a ſulphureous greeniſh yellow tincture. Some of it dropped into a glaſs of water ſhew'd itſelf quickly on the top with an equal ſurface, and after ſtanding ſpread itſelf through the whole liquor. Oil of tartar dropped into it formed a cloud to the bottom, equable, and waving by the motion of the glaſs.

On the reſidue of this tincture I poured the ſame quantity of ſpirit of hartſhorn, which grew black, reſembling a bitumen in conſiſtence; it fell to the bottom of the water without mixing; but after ſome time roſe up to the ſurface. Some drops of the ſolution of ſublimate precipitated a black powder, which thrown on a red hot iron ſparkled all over, but on a live coal flamed ſenſibly blue. Some of this matter was expoſed in a crucible for about five minutes to a moſt intenſe heat; about half the quantity remained, and it had ſtained the crucible with an indelible black colour. Some of the lac made as above neither melted nor flamed in

a ladle over the fire, the heat being increaſed, turned into a black cinder; but ſome of the lac being thrown into a red hot ladle, flamed and burnt into black aſhes. A lac of ſulphur made with quicklime gradually heated till red hot, did not flame but burnt to aſhes. I tried the ſame with the officinal lac ſulphuris, which did not flame, till the fire was haſtily increaſed, but the flame ceaſed upon taking the ſpoon from the fire, and the lac burnt into aſhes without flame. The ſame experiment, and with the ſame ſucceſs, was tried with the ſulphur of Aix.

A lac made with Scarborough water flamed not in a red hot ſpoon, though put on the fire, only in about a minute it ſhined above the brightneſs of a live coal. A lac made of our water appeared juſt like the other, both continuing in that bright ſtate a pretty good time before they were reduced to a black cinder. The reſiduum of Scarborough water after evaporation reſembled in colour the lac of both, and was tried in the ſame manner, and with the ſame ſucceſs. Though this appearance demonſtrated a ſulphur in the contents of both waters, yet as the lac of our well had not anſwered to open flame as formerly, I made further trials of the inflammability of the contents of both. I heated a crucible red hot, and removed every flaming coal from it, and caſt into it ſome of the reſiduum of our well, puſhing the fire by bellows. The flame gleamed within the crucible which it filled, continuing a conſiderable time. The ſame experiment ſucceeded with the reſiduum of Scarborough water. The flame in theſe trials appeared more white than that of ſulphur, reſembling that of nitre in deflagration. From equal parts of ſulphur and ſea ſalt thrown into a red hot crucible, aroſe a white flame, and much the ſame coloured one aroſe from nitre and ſulphur in equal quantities. The reſidue of the firſt was a grey concrete, of the latter a maſs like roſin. I could not perceive in theſe trials any ſmell of ſulphur. Hereby it appears that the ſalts attract the ſmoke of the ſulphur, imbibing it by the ſame mechaniſm as one

of

of them attracts that of coal, and both of them the moiſture of the air; and hence the difference of the flames.

To diſcover whether there was any thing reguline or metallic in theſe waters, I put about two drams of the reſiduum of Scarborough water with one half tartar, and as much nitre, into a crucible, with a cover to it, and kept it ten minutes in a ſtrong fire. After cooling it was eaſily ſhaked out of the crucible, and appeared white as before, only interſperſed with blackiſh particles. It's upper part appeared porous, the taſte was acrid, and it's weight little more than that of the tartar. The reſiduum of our water mixed with the ſame ingredients as above, and thrown into a red hot crucible, boiled immediately, and ſparkled, and then caſt up a thick cloud, with a high bituminous ſmell. After fuſion it adhered ſo cloſe to the crucible, that it could not be got out but in parcels by an iron; it looked like dark roſin, and had an acrid taſte. This appearance is like that of ſulphur and nitre deſcribed above, and is a proof of our water's being more of the nitrous kind, as the appearance of the Scarborough reſiduum, which reſembles that of ſulphur and ſea ſalt, may prove that it's ſulphur goes more on the ſalt, and that both are lodged in a calcarious earth, wherewith they are ſo combined, eſpecially the ſulphureous part, that the violence of fire cannot diſengage them; ſo that the ſulphur does not always diſcover itſelf. This compariſon receives further light from an evaporation of both waters. A quart of each was evaporated to about two ounces. Our water became of a deeper colour, and at length reſembled a ſtrong decoction of guaiacum in ſmell, taſte and colour. The Scarborough water looked like whey, and taſted more briny, in reſpect of the reſinous and mellowy taſte of the other.

The following trials carry on the compariſon ſtill farther.

1. Both waters changed ſyrup of violets green.

2. Scarborough water altered not the colour of blue paper. Our water made the colour appear ſomething more intenſe.

3. Neither ſyrup of violets nor blue paper change colour by a decoction of our water.

4. Scarborough water evaporated to one half turned ſyrup of violets green, but changes not blue paper.

5. Solution of ſublimate after ſome time turns a decoction of our water of a whiter colour, and then precipitates a duſky reſiduum.

6. Solution of ſalt of tartar with the ſame decoction preſently gives a precipitate equable as a cloud.

7. Solution of ſublimate changes the decoction of Scarborough water gradually into a duſky grey.

8. Solution of ſalt of tartar on the ſame decoction makes no notable change.

9. Infuſion of galls changes not the decoction of our water, but preſently makes a coagulum in decoction of Scarborough water.

By the firſt of theſe trials it appears, that the ſalt of both waters in their native condition goes moſt in the alkaline, as it appears by monſieur Tournefort's trials, the natural ſalt of the earth alſo does, whatever may be generally ſaid of it's acid nature. It ſeems by the third and fourth compared, that the ſalt in our water is more of the volatile ſort, agreeing hereby more with nitre. The fifth alſo may ſeem to confirm the ſame, but the ſeventh makes this more ambiguous; and the ſixth renders it yet more doubtful; and the ſixth compared with the eighth might rather ſeem to give the volatility to the ſalt of Scarborough water; but the ninth to reſtore the ſame ſtill to our water.

In ſuch counter appearances I tried if any thing more certain could be made out by various experiments with the reſidue of the waters, but the appearances were ſo little conſiſtent to thoſe above, or to one another compared, that I condemned them as unſatisfactory. I endeavoured next to analyſe the waters by putrefaction. Twelve quarts of our water were put into a ſmall caſk, it's mouth well cloſed and pitched

pitched and placed in a cellar during five weeks. Six quarts more were put in glaſs bottles. By my ſmell, taſte, or trials, I could find very little alteration in our water, other than the taſte and ſmell the ſimple element has in ſuch a caſe. Theſe eighteen quarts I evaporated in two braſs pans, one ſmaller, the other larger; the ſmaller was moſtly open, but the larger was covered during the evaporation. There remained in the leſſer pan twenty-four grains of a grey duſky powder. I obſerved the larger come into the conſiſtence and colour of bitumen, ſmelling and taſting high of the ſame kind. Some drops of oil of tartar in a little quantity of it formed a cloud. The bitumen evaporated before the fire weighed an hundred and ſeventy grains, and melted into a roſin, weighed two drams eleven grains. This flamed quickly in a red hot crucible, but the reſiduum of the ſmaller decoction did not flame, but ſparkled and made a noiſe as wet gunpowder does when fired. I can attribute the variety to nothing elſe, but the greater pans being covered during the decoction: of ſuch conſequence it may be to have our decoctions more or leſs circulated.

Upon the whole it appears that analogy is capable to lead us into the nature of things, and that experiments juſtly ſtated will always anſwer to ſuch analogy, and hereby is confirmed the likeneſs of our water with that of Scarborough as to their ſpecific contents, though in proportions different from each other, the ſalts abounding more in that of Scarborough, the ſulphur in ours. Analogy has taught me the preſence of theſe ſalts; Dr. Short and Dr. Shaw have found them by trial; thus does the fact confirm the analogy. The evidence appears equal concerning the nitre and ſea ſalt in both: as to the quantities, I made the following obſervation. The reſiduum of Scarborough water imbibes the moiſture of the air ſo ſtrongly, that upon drying ſome of it, it loſt near one third of its weight, while eighteen grains of the reſiduum of our water expoſed to the air and then dried, loſt but one grain and

and a half. This with the comparative colours I always obſerved in the reſidua of each, that of Scarborough going conſtantly on the grey white, and that of our well on the duſky brown, proves ſtill the prevalence of the ſalts in Scarborough water, if not of the calcarious earth, and of the ſulphur in ours. To which may be added, that having brought my laſt decoction of our water to about a gill, I dropped thereon ſome oil of tartar, and it formed an equable cloud of an equable ſurface and conſiſtence all over, ſtanding firm ſeveral days; and it appears above that the decoction of Scarborough to one half gave no ſuch appearance.

Medical qualities of Montroſe well, with ſome inſtances thereof by the ſame. Vol. 3. art. 9.

THE water of this well is of a mineral taſte which cannot well be deſcribed. It ſets lighter on the ſtomach, and is eaſier to digeſt than any other ſpring or mineral water. The moſt tender eaſily bear it, and find their appetite and digeſtion improved by it. A man of ſeventy years of age, of a decrepid habit, bore eaſily, when he firſt began to drink it, two quarts in a morning, and near as much after noon with the alleviation of a cough, though he could never formerly bear a draught of any manner of water. It clears and enlivens the ſpirits of thoſe who live on a low diet, ſuch as live high are relieved of the indigeſtion which clogs the natural faculties, by a cold or hot infuſion of tea made with ſimple water. But a ſmall quantity of it has this effect on the more abſtemious. A gentleman who lived chiefly on a vegetable diet, and the ſimple element, of a thin habit of body and lively ſpirits, found himſelf yet more chearful, and his appetite and digeſtion improved by drinking a pint. It is univerſally diuretic, being drank from two to three pints it purges, half the quantity ſucceeds in ſome. By this quantity a gentleman was ſet

ſet a purging three or four days together, and was obliged to diminiſh the doſe till he was more accuſtomed to it. The more plentifully one feeds the more it operates. In ſome the ſame degree of operation hath continued during the uſe of the water: But as people are more accuſtomed to it, they are obliged to intermit at times its uſe, or to augment the quantity.

Soon after its virtues were firſt obſerved, it performed a cure ſcarce inferior to any recorded in obſervations of medicine. A girl during nine years, almoſt from a child, was afflicted with a ſtrangury, ſtoppage of urine, and for moſt part of the evacuations of her belly. Her urine conſtantly as a thick gleet reſembled a mucilage of oatmeal, and during moſt of the time ſhe had ſcarce any intermiſſion of ſymptoms, whereby her fleſh waſted, and her ſtrength was ſo much impaired that ſhe could not walk without aſſiſtance. At length the paroxyſms taking her conſtantly ſo ſoon as aſleep, ſhe became inſenſible, talking and anſwering things abſurdly. In this condition ſhe drunk freely of the waters at the well, which paſſing off by ſtool and urine, gave immediate eaſe. By continuing the waters, the evacuation ſtill ſucceeded, and in few weeks ſhe was not only cured, but became of a natural full habit of body. Many in various ſymptoms of gravel and nephritic pains have been relieved by it, and moſt of them remarkably. A gentleman who for many years had been afflicted with paroxyſms of the ſtone, which frequently ſeized him, and from which he was only relieved by paſſing of ſtones of various bigneſs, took to drinking of this water in a morning, which going off plentifully by urine, and moving the belly a little, freed him of all nephritic paroxyſms, and made him freſher in all his faculties. One circumſtance in his caſe was remarkable, that during the uſe of the water, he paſſed urine without any ſtimulus, or inclination to paſs more, which inconvenience had conſtantly attended him from the firſt attack of the diſeaſe.

Another

Another gentleman, who for ſeveral years had grievous ſymptoms of the ſtrangury, and ſometimes paſſed gravel, uſed ſeveral means for relief, and particularly the Aberbrothoc water, to no purpoſe. At length an ulcer was ſuſpected in the neck of his bladder, where he ailed moſt, from a purulent diſcharge with his urine. After all hopes were almoſt gone, the ſymptoms inſenſibly abated, but the diſeaſe remained, his urine paſſed with difficulty, a ſtrangury following it. He began with ſomething more than a pint of this water in the morning, and drunk a warm infuſion of it on tea after noon. His belly grew more open, he paſſed his urine with more freedom, and the pain diminiſhed daily. This water generally relieves in ſcorbutic diſorders, and hath perfectly cured ſeveral inveterate ſcurvies both in young and old, and is more efficacious than any I have obſerved. A gentleman of a ſtrong conſtitution, labouring many years under foul eruptions, almoſt coming to a degree of leproſy, by drinking from three to four quarts a day, which gave him three or four ſtools, and dipping his ſhirt in the water for a bath over night, was perfectly cured in three weeks. The eruptions which were thick, inflammatory and ſanious, went all away, and his ſkin became ſoft and ſmooth. He has continued in perfect health above a year, now and then drinking the water at ſix miles diſtance.

A woman of ſixty years of age had been afflicted for ſeveral years with ſcorbutic runnings over ſeveral parts of her body, particularly her head. Diet drinks proving of no uſe, ſhe drank three pints of this water a day, whereby ſhe purged three or four times, was entirely cured and remained ſo a year after.

A girl eight years of age, labouring almoſt from her birth under a dry itching ſcurf, after ſeveral meaſures had been taken in vain, by drinking for three weeks about two thirds of a pint of water a day, and bathing twice a week, was made clean, and the diſeaſe ſometimes threatning to return hath been cured by the ſame means, and is now perfectly ſound.

In

In winds and flatulencies pent up in the bowels it hath proved of good ufe. Others have found benefit from this water who could not bear drinking the fimple element cold. So hath it made cures by ftool and urine in fpafmodic colics. A woman labouring under racking pains of her head and breaft, by drinking it, paffed turbid urine in large quantity, and was cured without purging.

It has alfo done fervice in difordered fecretions, and where the liquors have been in a ftagnating way. A young man, after a tertian ague of three months continuance, fwelled all over the belly, arms and head, and was cured by drinking the water every day for two weeks.

A woman who had fpit blood every third or fourth day for a year and a half, fuppofed owing to a ftrain, from the time fhe began to drink this water, which fhe continued for two weeks or more, fpit none, neither did any bad fymptom appear, although the water operated every day both by vomit and ftool. She drank two quarts. But to prevent fuch operation took but one, which neverthelefs had the fame effect; and I am told fhe continues well.

In rheums and ftrains it is of good ufe by way of cold pump, even where perfons could not bear fuch ufe of ordinary cold water. A gentlewoman of a thin habit and advanced age, had a rheum in her arm of long continuance as good as quite cured, and the pain allayed. But the rheum attacking the other arm, fhe was afraid to admit of the water.

A gentlewoman from a ftrain in her foot could not move her toes, nor put her fole flat to the ground for almoft a year. The flefh of her leg remarkably wafted, her fkin became difcoloured, rough and as it were dried, not being able to bear the application of ordinary cold water, by bathing and pumping this on her foot and leg for two weeks, fhe began to move her toes, then all her foot; her leg recovered its native colour and foftnefs and became plumper, fo that fhe began to walk about a little, when by an unhappy

fall ſhe made her leg worſe than at firſt, and not finding immediate relief from the water laid it aſide, to try other means which have had no ſucceſs.

A man affected by the palſy, both in his limbs and underſtanding, got cured by drinking the water and bathing in it.

The ſpring is but ſmall, giving only two quarts in a minute.

Remarks on Chalybeat waters, by ALEXANDER MONRO, *P. A. in the univerſity of Edinburgh, and F. R. S.* Vol. 3. art. 7.

IN the following enquiry into chalybeat waters, I propoſe to conſider them only with regard to their medical uſe, to diſcover what their real or comparative ſtrength is, how they bear carriage, and how long they retain their virtues, that phyſicians may judge which of them is moſt proper in the various diſeaſes and circumſtances of patients, which muſt be drunk at the fountain head, and which might conveniently be drank at a diſtance from it.

As the aſſiſtance of others is neceſſary in an enquiry of this kind, ſome general method muſt be laid down by which all the trials ſhould be made, otherwiſe there will be an inſuperable difficulty in comparing them. Some writers content themſelves with telling us that ſuch waters ſtrike a red, purple, violet or black colour with galls, and that this change of colour is a certain mark of a chalybeat water, and that the deepeſt colour ſhews the greater proportion of ſteel. To ſatisfy myſelf of the truth of this, I made a weak ſolution of ſal martis in water, and found that with tincture of galls I could form all the different colours, the larger quantity of the ſolution always requiring the greater number of drops of the tincture to bring it to all the colour it could take, and that it was deeper in proportion to the quantity and ſtrength of the ſolution and tincture employed. If

words

words could exprefs the various fhades of colours betwixt the pale red and the black, the fimple experiment of bringing fteel waters to the deepeft colour they could ftrike with galls, might determine the proportions of fteel in each. But as this is impracticable, and as it is neceffary to know the quantity of fteel contained in any given quantity of water, fome general ftandard muft be appointed to which all may be brought. To obtain this, I made feveral experiments to find out the quantity of fteel in its artificial falt, and found it to be a little more than a third part. I diffolved fome of the falt in water. Twenty ounces of the folution contained an ounce, except a fcruple, which was precipitated: one hundred and forty two drops of this folution weighed two drams; every drop therefore contained one twenty fifth of a grain of falt, or one feventy fifth of a grain of fteel. To compare a chalybeat water with this folution, into a known quantity of fuch water, drop a ftrong clear tincture of galls, allowing a fufficient time between each drop for its full effect, till the addition of more tincture makes no change. This experiment fhould be repeated to come at the exact number of drops requifite. Then mix the fame number of drops of tincture with as much common water as there was mineral in a glafs, exactly like that made ufe of in the preceding trial. Drop in the folution of fteel cautioufly till the colour is the fame with that of the mineral water. By this means the due proportion of the folution to imitate any fteel water may be known. I have thus made fountain water fo like to feveral chalybeat waters that none could diftinguifh them.

Tincture of galls is more convenient than in fubftance for making thefe experiments, for it acts much fooner and more equally, and can be added in lefs quantities, which deferves to be regarded; for too large a proportion of galls poured at once into fteel waters will be fo far from ftriking the colour ftronger or fooner, that no change will happen for feveral hours after, and at laft the water gradually becomes of a

deep

deep ſea green colour inſtead of purple or violet. Good chalybeat waters may have been condemned as containing no iron, or as being impregnated with copper, from an addition of too much galls. Freſh tincture of galls is preferable to that which has been long kept; but even ſuch as was grown mouldy and had a thick ſediment, anſwered the common trials. I would recommend frequent trials to be made at different times with water bottled at different ſeaſons, in order to aſcertain the proper ſeaſons for bottling mineral waters, and to find out the time which each will keep. It is alſo requiſite to obſerve what time it is before the galls ſtrike the full colour, and how long it remains in an open glaſs, for Mr. Geoffroy's ſuppoſition appears reaſonable that both theſe effects will be moſt ſlowly produced, when the ſteel is moſt intimately blended with the other principles of the water.

To make the account of the ſpaws compleat, their other contents ought to be ſought after by mixing different ſubſtances with them, remarking the changes they undergo in ſmell, colour, &c. by keeping, and by extracting their ſalts and earths after evaporation.

There is a ſtrong reſemblance between our ſteel waters and common water in which ſal martis is diſſolved, but the natural ſpaw expoſed to the air ſoon loſes its chalybeat taſte, and will not ſtrike a purple colour with galls; expoſed to heat, its virtues are ſooner loſt, and becomes vapid in no long time in the cloſeſt veſſels; but a ſolution of ſal martis bears heat, and being expoſed to the air without alteration, I ſuſpected that this difference depended upon the ſmall proportion of the vitriolic principles, and ſome change they might thereby undergo in the water, and therefore having added as much ſal martis to ſome bottles of water as had been found to make it of the ſame taſte, and to ſtrike the ſame colour with chalybeat waters, I corked ſome carefully, others leſs carefully, and a third ſort I left open. The water in theſe laſt loſt its taſte and virtues in a fortnight, became muddy, and had a ſaffron coloured powder at the

the bottom. The ſecond kind kept longer, but had a ſtinking ſmell before it became vapid. The water which was carefully corked and roſined kept well, but acquired a ſtrong ſmell of rotten eggs like to what ſeveral ſpaws had when kept; when the bottle was left open, the ſtinking ſmell went off; ſoon after, the chalybeat virtues were not to be obſerved, and the bottom of the bottle was covered with the ſaffron coloured powder, which is generally to be ſeen in bottles where chalybeat waters have been kept. The difference therefore between the natural and artificial ſteel waters conſiſts in the greater volatility of the former.

Spaw and Pyrmont, and ſome of our own chalybeat waters ſeemed to me an exception to the reſemblance between the diluted ſolution of ſalt of ſteel and the natural ſteel waters, for the colour they ſtrike with the galls is faint, while their taſte and other effects are ſtrong. This made me endeavour to imitate them. I mixed filings of iron, oil of vitriol, and water in a Florence flaſk, which I laid on it's ſide, and immediately fitted another to it in which was ſome fountain water. The fumes which aroſe upon the effervescence of the oil of vitriol with the ſteel, came over into the other glaſs. After the efferveſcence was over, I took away the glaſs with the water which was limpid, but had a ſtrong empyreumatic ſmell; it's taſte at firſt was pungent, and then the acidulous taſte prevailed. When tincture of galls was mixed with it, it became of a purple but faint colour, which held many days without precipitation. Next morning the empyreuma was gone, and the water had an agreeable ſpaw taſte. In leſs than a day this went off, a ſmall quantity of ſaffron coloured powder fell to the bottom, and the galls had no effect on the water.

This water gives no ſigns of acidity as I ſuſpected when mixed with ſyrup of violets and clove gilliflowers, in the colour of which it makes no alteration; neither do the more ſpirituous ſpaws; whereas the ſolution of ſalt of ſteel, and ſome ſpaws appear

alkaline from changing the colour of both the ſyrups green.

The ſucceſs of this experiment made me try ſome others, to diſcover what it was that evaporated, and what precipitated in theſe waters. Oil of vitriol poured on the ſaffron-coloured reſiduum made no efferveſcence: upon the addition of a little water, ſome of the powder ſeemed to be diſſolved. Tincture of galls changed not the colour, but upon adding of ſpirit of hartſhorn, a great efferveſcence aroſe, and a deep purple coagulum was made. The ſame experiments ſucceed with ruſt of iron, which reſembles this powder. Neither ruſt or the powder, when ſuſpended in water ſtrike any colour with galls, although crocus martis did. What evaporates is the menſtruum(a), which carries away ſome of the principles of the iron with it. From ſeeing the effects of acid and of the air upon iron, and finding vitriol naturally formed, it may reaſonably be ſuppoſed, that the menſtruum of the irony particles in theſe waters is an acid. From conſidering how much ſulphur is in iron, what a ſtinking ſmell mineral waters have before they turn vapid, and how much the ſulphur of iron is deſtroyed before the iron turns into ruſt, which again reſembles the powder precipitated in theſe waters, we may fairly ſuppoſe that the menſtruum carries the ſulphur along with it, and leaves only the earthy parts with a ſmall proportion of ſulphur.

May not ſteel waters be impregnated with common groſs vitriol, or with the more ſubtile fumes of iron

(a) That the menſtruum does really fly off has not been made to appear by any ſatisfactory experiment, as has been remarked above. It is admitted that air is contained in theſe waters (perhaps generated at the time that the iron was diſſolving in them) and that it ſoon extricates itſelf when under no great degree of natural or artificial compreſſure, and that ſoon after, its metallic contents are precipitated, that is, are brought nearer to one another, and run into freſh combinations, till their gravity exceeds the force with which the fluid attracts them. For further information, ſee Dr. Shaw's excellent treatiſe on Scarborough water. P. 161.

diſſolved in the natural menſtruum; or with both in different proportions?

Will not the quicker precipitation, and leſs volatility of chalybeat waters, ſhew the ſulphur not to be ſo much freed from the earthy particles, as in others which precipitate more ſlowly, and are more volatile?

Will not the common obſervation of air generated in all effervеſcencies, fermentations, putrefactions, and wherever a conſiderable change is produced in the compoſition of bodies, account for the quantity of elaſtic air, obſerved in chalybeat waters, in the more ſpirituous when recent, in others when the putrid ſmell ſhews the ſulphur to be more diſengaged?

Are not the different kinds of ſteel waters to be preſcribed, according as there is occaſion for a ſubtile penetrating ſulphureous ſpirit to pervade the ſmalleſt veſſels, or according to the quantity of an abſorbent aſtringent earth, which is required to be joined with this ſpirit?

Where different ſpaws are not to be had, may not the ſame water be made to anſwer each of theſe intentions, according to it's being more or leſs kept, or expoſed to the air or heat?

Materia Medica *and* Pharmacy.

A Dissertation on Opium by Dr. CHARLES ALSTON, *Professor of Botany and Materia Medica in the University of Edinburgh.* Vol. 5. art. 12.

SECT. I.

OPIUM is the milky juice which issues from incisions made in white poppy heads, thickened in the open air, into a solid, but softish, resinous gum, of a dark reddish-brown colour; and of a hot bitter taste, and strong soporiferous smell, brought from the Levant and the East Indies, in round, flat cakes, or more irregular loaves of different sizes, from four ounces to a pound and upward in weight, and covered with leaves or other vegetable matter, to prevent their running and sticking together.

It is disputed whether the opium now used is made of the milk, or of the expressed juice, or of the decoction of one and the same plant. Kempfer asserts, that it is the milk drawn from poppy heads by incision, and is very circumstantial in describing the manner of collecting it. On the other hand, Prosper Alpinus asserts, that the opium of the shops is nothing but a meconium. Mr. Lemery (a) says, that there is no other opium than the meconium, or the extract of the leaves and heads of the poppies of Egypt. Mr. Savary (b) is of the same opinion. And Mr. de la Condamine (c) affirms, that there is no true opium at Constantinople, but that it is an ex-

(a) Dict. des drog. in opium.
(b) Dict. de commerce.
(c) Memoires academ. roy. an. 1739. p. 427.

tract

tract of the poppy by decoction; and that the most esteemed is of a penetrating smell, and of a very deep greenish brown colour (a) on the outside before it is dried; but yellower and clearer within. The greatest part of that sold at Constantinople is brought from Natolia. Opium grows also in the territory of Thebes in Egypt; but even there the Natolian is preferred, and sells for double the price of that of the country.

To these testimonies if we add from Petrus Bellonius the marks of the best opium (b) and it's low price, we shall be ready to conclude we have nothing but the meconium. But that our opium is neither an extract nor an inspissated expressed juice of poppies may be demonstrated; for the milky juice drawn by incision from poppy heads, and thickened either in the sun or shade has all the characters of good opium. To obtain it I followed the directions of Dioscorides, and on a dry day before noon I cut off the crown of the poppy heads so as to avoid penetrating into the cavity of the fruit, and collected the milk with a silver spoon into a China cup. The juice in a few days thickened to the consistence of opium in the open air, which was of a fiery hot bitter taste and soporiferous smell, and more so than the common opium, of a dark yellowish brown colour on the outside, somewhat lighter within, and appeared as if composed of drops: after ten years keeping, its colour and taste remained. This agreed with Bellonius's best opium. May it not be called opium in the tear (c)? If it may, it is to be found every where. This was from the papaver hortense semine albo; sativum Dioscoridi; album Plinio C. B. P. or white poppy. I gathered opium also from the papaver vulgare, cujus capitula foraminibus hiant, semine incano, ἀγριωτερὸν Dioscoridi.

(a) Verd brun tres fonce.

(b) Opium optimum est amarum, gustu calido fauces incendens, flavescens, Leoninorum pilorum modo; in massam veluti ex granulis diversi coloris coactum. Legendo enim opium ea grana in papaveris capitibus collecta cohærent, & in placentulam quodammodo coeunt. Lib. 3. Obs. 15.

(c) En larme.

C. B. P. or wild poppy. It was a little lighter coloured, but this I thought accidental, for the milk turns ſoon black on the knife.

I afterwards ſlightly ſcarified ſome poppy heads after the Perſian manner. When the juice was thickened I ſcraped off the opium, and obtained more of it than by the other method. That I might procure the tear in its utmoſt perfection, I cut off the ſtar from ſeveral heads, and bending them down, ſuffered the milk to drop into a cup. It grew as ſolid as opium, and being formed into a lump appeared uniformly white, nor was there any difference in the juices of different poppies.

Secondly, the extract and inſpiſſated juice ſcarce any way reſemble opium, nor is their taſte and ſmell like it. The extract appears black when dried, and ſo does the juice, but when diluted the firſt is brown, the latter green. The extract is tough and adheſive, the juice rough and friable, and grows mouldy in a day or two after expreſſion. Opium may poſſibly be mixed with either of theſe, and the greeniſh brown opium may have ſome ſmall portion of the juice in it. It's penetrating ſmell is certainly owing to ſome aromatic ſubſtance mixed with it.

Thirdly, opium contains more roſin than either the inſpiſſated juice or extract. One third of opium appears to be roſin, while the juice and extract ſcarce yield one tenth part.

Fourthly, if opium was not the tear of the poppy, there would be no occaſion for ſowing ſo many fields with poppies in Egypt and other places. Nor would it be ſo powerful a medicine, for it's anodyne virtues depend chiefly on the milky juice.

The objection drawn from the low price of opium is of no force, for in this climate, where the heads are ſmall, I could in an hour's time collect a dram of opium, without the Perſian knife, or that dexterity which is acquired by practice. I wonder therefore that none of the French writers on opium made it or the meconium, ſince Bellonius gave the hint, and Quer-

Quercetan proved it practicable. In the mean time, I conclude that the greateſt part of opium is the tear of the poppy.

2. There remains another controverſy whether opium is got from the black or white poppy. The ancients, particularly Pliny(a), declare it was prepared from the black. Dioſcorides writes, that the poppy with the black ſeed is called ῥοιὰς διὰ τὸ ῥεῖν ἐξ αὐτῆς τὸν ὀπὸν, becauſe the juice flows from it; and alſo after giving the virtues of the ſeed τῆς μέλαινης μήκωνος, of the black poppy, he immediately adds, ὁ δὲ ὀπὸς καὶ αὐτὸς ψύχων ἐπιπλέον, καὶ παχύνων, καὶ ξηραίνων, &c. But the juice itſelf is more cooling, and incraſſating, and drying, &c. viz. than the ſeed of the ſame black poppy; and he no where ſays that the ὀπὸς is got from the white. It is of no conſequence with reſpect to the medicine which ſort be choſen, as the juice of both have the ſame effects. But as the largeſt poppies afford the greateſt quantities of opium, they are cultivated to advantage, and accordingly made choice of in Cambaya, Perſia, and other places.

3. As to the choice of opium, it is ſufficiently known (b), as may be determined by the following experiments. Dioſcorides relates that opium is ſophiſticated by the addition of glaucium, gum, juice of wild lettice, ſuet and tallow. But it is probable that only an innocent liquid is mixed with it, or a milky juice of the ſame nature with that of poppies, otherwiſe it would not be ſo ſtrong as what is made here. The wild lettice, or lactuca ſilveſtris odore viroſo. C. B. Pin. 123 abounds with a milk of the ſame taſte and ſmell with opium, and therefore may poſſibly be mixed with it, and without detriment, ſince the milk of the common lettices is anodyne and ſomniferous.

4. Authors relate that opium is covered with poppy leaves, but what I have ſeen was covered with flow-

(a) Alterum genus eſt papaveris nigrum, cujus ſcapo inciſo lacteus ſuccus excipitur (l. 19. c. 8.) e nigro papavere ſapor (or ſopor) gignitur, ſcapo inciſo, l. 20. c. 18.

(b) V. Wedelius, opiol. l. 1. c. 4.

ers, ſeeds, and chaffy huſks, &c. of ſome of the dock kind.

SECT. II.

Opium & opium Thebaicum, off. Ὀπὸς μήκων& & ὑπνωτικὸν μηκώνιον, Hippocrat. morb. mul. l. 2. Μήκωνος ὀπὸς, Dioſcorid. l. 4. c. 65. Galeni, ſimpl. med. l. 7. c. 12. §. 13. Oribaſii, l. 15. Opion, Plinii, l. 20. c. 18. Ὀπιὸν Galeni de comp. med. S. 6. l. 3. c. 1. Pauli, l. 7. Opium, Acoſtæ Cluſ. exot. 257. Bellonii, ibid. 178. C. B. Pin. 494. J. B. 3. 392. R. H. 854. Opium, Mauritanis & Indis oſium, Luſitanis Amfiam Garciæ, Cluſ. exot. 154. Opium, quod Aſia cum Egypto afiuun, & oſiuun vocat, Kempfer. amœnitat. exot. 642. opium.

Papaver, & papaver album, off. Papaver hortenſe ſemine albo, ſativum Dioſcoridi, album Plinio, C. B. Pin. 170. Papaver ſativum, Dod. 445. J. B. 3. 390. R. H. 853. Papaver ſativum album, Ger. emac. 369. papaver ſimplex, ſativum, album, Park. Theat. 365. papaver hortenſe, H. Ox. 2. 275. papaver album, ſativum, Kempf. amœn. exot. 639. papaver foliis ſimplicibus glabris inciſis, Lin. H. Cliff. 200. The white poppy.

The name opium was probably given to this juice by Pliny, Galen being the firſt among the Greeks who uſed it. For the etymology and various ſignifications of ὀπὸς, μήκων, &c. conſult Wedelius (a) and Bodæus (b). If there was any difference between the ὀπὸς μήκονος and ὑπνωτικὸν μηκώνιον of Hippocrates, the laſt probably was the meconium of Dioſcorides, or rather of Pliny.

Whether the Greeks or Egyptians were the inventors of opium is not determined, but it is probable that the Greeks firſt diſcovered it's ſoporiferous quality, and poſſibly about the time of Hippocrates; for although he mentions the ὀπὸς μηκών& and ὑπνωτικὸν

(a) Wedelii opiolog. l. 2. c. 1.

(b) Bodæus a Stapel. in Theophraſt. 591, 965, 1097, &c.

2 μηκώνιον

μηκώνιον too, yet it is but once (a), and he ſeems never to have uſed it as an hypnotic or anodyne, and Dioſcorides informs us, that Diagoras the diſciple of Democritus, who lived very near the time of Hippocrates, condemns the uſe of it in diſorders of the eyes and ears, becauſe it dims the ſight, and cauſes a continual deſire of ſleeping (b). Hence opium was not then well known, otherwiſe Hippocrates would have uſed it oftner, and Diagoras not have objected to it for it's ſoporiferous quality. To which may be added, that Heraclides of Tarentum, who flouriſhed two or three hundred years after Hippocrates, is ſuppoſed the firſt who preſcribed opium with theſe intentions.

It has been the opinion of many learned men that opium was the nepenthes of Homer (c), which Helen had learned of Polydamna the Egyptian; and this appears not altogether improbable, ſince the effects which the poet (d) aſcribes to his medicine, agree with the known ones of opium, for which Egypt was long famous. Yet many reaſons might be objected againſt this conjecture; for, 1ſt, Neither Theophraſtus, nor Pliny, who both mention Homer's nepenthes, nor any of the ancients took it for opium, nor tell us what it was. 2dly, One of Homer's anodyne medicines (e) he calls expreſsly a bitter root (f). Now the helenium not only takes it's name from Helena, and is called by the poets bitter emphatically, but had alſo the virtues of the nepenthes aſcribed to it of old (g). 3dly, The Egyptian, Arabian, Perſian and Indian names of this juice are all evidently derived from ὀπιον, and, as Cluſius (h) obſerves, the Arabians pronounce

(a) De morbis mulierum, l. 2. p. 670. in ſuffocatione uteri.

(b) Δια το αμβλυωπεις ειναι και καρωτικον.

(c) Odyſſ. 4. v. 217, &c.

(d) Φαρμακον νηπενθες ακολοντι.

(e) Ὀδυνηφατα φαρμακα.

(f) Ῥιζαν πικρην, iliad, λ. v. 845.

(g) Helenium ab Helena, ut diximus, natum, favere creditur formæ——Attribuunt & hilaritatis effectum eidem potæ in vino, eumque quem habuerit nepenthes illud prædicatum ab Homero, quo triſtitia omnis aboleatur. Plin. hiſt. nat. l. 21. c. 21.

(h) Cluſ. exot. p. 244.

it opion. Bontius indeed derives the Greek name from the Arabian (a), but he might as juſtly derive Theriaca and Theriaca Andromachi from Theriaki, and Theriaak Faruuk of the Perſians.

Upon the whole, as I cannot affirm that helenium was the nepenthes, ſo, if it was opium, one would think ſome of the ancient phyſicians, who were neither ſtrangers to Egypt nor Homer's works, would have made this diſcovery long before the ſixteenth century.

As to the opium plant, 1ſt, It is very evident that it was cultivated long before the time of Hippocrates; for Homer (b) borrows a beautiful ſimile from the garden poppy; and Livy (c) and Pliny (d) and all the Roman hiſtorians take notice of the poppy-heads in Tarquin's gardens. The invention of this plant was attributed to Ceres, and from it ſhe was named Mecone: it was offered in her ſacred rites, and ſhe was repreſented holding it in her hand. The Romans never would have done ſo much honour to a vegetable merely for it's narcotic quality: they reckoned it one of the frumenta which Ceres taught the Greeks to cultivate and uſe, for which ſhe was deified: the ſeed of the poppy was uſed in food, and particularly in deſerts. This D. Le Clerc (e) acknowledges, but he thinks it was on ſome other account than for nouriſhment, or that the manner of dreſſing it diveſted it of the ſomniferous and noxious qualities. But I am of a contrary opinion, and think it nouriſhing, and

(a) Affion, ac quibuſdam Amphion Arabibus & Indis, opium Græcorum eſt; indeque magis adducor ut credam, Græculos a vetuſtiſſimo populo vocabulum opii derivâſſe, cùm ab omni memoriâ illi uſi ſint; Græci vero tantum noxas hujus medicamenti videntur noviſſe; uſum vero ac virtutes ejus plane divinas non ſatis exploratas habuiſſe. Animad. in Garciæ, c. 4.

(b) Iliad. θ. v. 306.

(c) Lib. 1. c. 53.

(d) L. 1. c. 53. Papaver fuiſſe honore apud Romanos ſemper indicio eſt Tarquinius Superbus, qui legatis a filio miſſis, decutiendo papavera in horto altiſſima, ſanguinarium illud reſponſum hac facti ambage reddidit.

(e) Hiſt. de la medic. p. 211.

not ſomniferous or noxious; for even Hippocrates (a) calls it nouriſhing; and poppy-ſeed is of a more delicious taſte than ſweet almonds; it is oily and farinaceous; and I have eaten large quantities of the black as well as the white ſeed, and never found it ſomniferous or noxious: beſides, it is ſtill uſed in food in ſome places, as well as the expreſſed oil, which is as wholeſom as olive oil (b). If this ſeed was noxious, baking would not free it of it's bad qualities, the narcotic parts being not volatile; hence is confirmed what was ſaid above, viz. that the anodyne and ſoporiferous virtues of the poppy are lodged only in the milk; in this it is not ſingular, for the milk of the common garden lettices is hypnotic, while the reſt of the plant is cooling, diluent, and nouriſhing.

2dly, Our garden poppy does not ſpecifically differ from the μήκων, or papaver of the ancients; for although we cannot collect an exact deſcription of it from their writings, yet they have ſufficiently diſtinguiſhed it by ſeveral marks: from Theophraſtus we learn that the μήκων is an herb, which does not caſt it's leaves, contains ſmall ſeeds in heads from which a milky juice is collected: from Dioſcorides, that it is cultivated in gardens, and has white ſeeds in oblong heads (c), with an aſteriſk on the top; whence by ſcarification is got opium (d). If to this we add what he writes of the juice of poppies, and the fame of the mithridatium and theriaca in all ages, it will be evident that our poppy is the papaver of the ancients, and that their opium and ours is the ſame. This may appear to ſome a mere hiſtorical nicety; but if the identity of the medicine be not firſt demonſtrated, we cannot be benefited by the experience and obſervations of former ages. Happy had it been for phyſic if the ſame nicety had been obſerved in every ſimple to which we give Greek or Latin names.

(a) Τροφιμὸν δὲ καὶ ἰσχυρὸν. De dieta, l. 2.
(b) V. Matthiol. p. 746. Geoffr. M. M. vol. 2. p. 713.
(c) Κωδίαι.
(d) Ὀπὸς μήκωνος.

I have

I have made opium Thebaicum a ſhop name of this juice, becauſe of the reputation it formerly had of being the beſt, but in reality the Egyptian opium is not better than the Natolian, if ſo good.

I ſhould conclude this ſection with a botanical deſcription of the poppy, but as it could be little elſe than a tranſcript of that in the plantarum hiſtoria Oxonienſis added to the character of the genus given by Linnæus, I ſhall paſs it with this remark, that though Moriſon deſcribes the white poppy as a ſpecies different from the papaver hortenſe nigro ſemine ſylveſtre Dioſcoridi, nigrum Plinio C. B. Pin. or the black poppy; yet the papaver ſativum of J. B. includes not only theſe two, but ſeven more named in C. B. Pin. and conſequently the firſt twenty ſix ſpecies in Tournefort's inſtitutiones.

SECT. III.

Opium eaſes pain, procures ſleep, promotes perſpiration, but checks all other evacuations, chears the ſpirits, incraſſates the humours, and relaxes the fibres. Hence it is recommended in intenſe pains, want of reſt, and in all diſeaſes proceeding from tenſion or irritation of the nerves, irregular motions of the ſpirits, or from thinneſs or acrimony of the fluids.

In the following propoſitions or obſervations, I have examined opium every way I could think of whereby the qualities of bodies and their influence on us are diſcoverable, in order to find that particular change it makes on our fluids or ſolids, which I call the primary effects of a medicine, from which and the mechaniſm of our bodies the ſecondary do proceed.

1. Opium is acrid, bitter, and ſtrongly odoriferous. Dioſcorides ſays its taſte is bitter, and ſmell ſoporiferous; Matthiolus, that if kept ſome time in the mouth, it ulcerates the tongue and palate. On attentively taſting opium, at firſt a nauſeous bitterneſs is perceived; then a pungent heat affects the tongue, next the palate, and laſt of all the lips. The heat con-

continues ſome time, the bitterneſs longer, provoking a plentiful diſcharge of the ſaliva. It alſo heats the noſe, and creates an inclination to ſneeze.

Were we to judge of the virtues of opium from hence, we ſhould reckon it acrid, diaphoretic, nervine and cathartic. It certainly is diaphoretic, and may be called nervine, but not purgative, though by accident it ſometimes is ſo. Eraſtus thinks, that if it were not for its ſtupifying quality, it would always prove cathartic, According to his opinion, the narcotic virtue depends not on ſenſible qualities; and it is probable, for ſome narcotics are acrid, others mild; ſome bitter, others ſweet; ſome odoriferous, others inodorous; ſome purge, others ſtop ſuch evacuations, &c. and yet all of theſe are anodyne, and almoſt equally narcotic and virulent. It is alſo obſervable, that many cathartics are equally acrid, bitter, and ſmell as ſtrong as opium, and yet are no ways narcotic. Conſequently we ought to diſtinguiſh between the ſtimulating and narcotic qualities of opium.

Theſe ſtimulating qualities ſufficiently refute the notion of the refrigerating faculty of opium, and prove it to be a hot medicine, though in many caſes it diminiſhes preternatural heat.

2. Opium conſiſts of five parts of gum, four of reſin, and three of earth, not diſſolvable either in watery or ſpirituous menſtruums.

I diſſolved opium in water, wine, vinegar, ſpirit of wine and brandy, and drew a tincture from it with ſpirit of wine rectified with ſalt of tartar, keeping always the proportion of one part of opium to twelve of the menſtruum, and found (α) that alcohol diſſolved four twelfths of opium, there remaining eight, of which water diſſolved five, and left three of fæces. (β) Water diſſolved eight twelfths, and of the four remaining alcohol diſſolved one, leaving of earthy parts as above. The proportions indeed were not always the ſame, but varied not much. Hence water diſſolves about three fourths of the ſulphur of opium.

opium. I found alſo (γ) that water diſſolves opium as well and as ſoon as wine, vinegar, or ſpirit of vinegar; only the ſolution in water in three or four days becomes turbid and ſoon after mouldy, ſeparating from it a whitiſh ſubſtance containing part of the diſſolved reſin. (δ) That proof ſpirits diſſolve both the gummy and reſinous parts of opium. Hence there being in twelve parts of brandy about eight parts of water, ſo much water, wine, or vinegar is a ſufficient menſtruum for one part of opium. But though I tried this proportion of eight to one, and it anſwered, yet becauſe twelve to one completed the ſolution ſooner I kept to it. For (ε) water, wine, vinegar and brandy, in the proportion of twelve to one, took but four or five days for the ſolution without heat, if frequently ſhaken; but water in the proportion of eight to one took ten or twelve days. Alcohol requires about a month. And (ζ) the reſiduum of a ſolution of opium in cold water contains nothing which boiling water can extract. Suppoſing therefore that the reſin of opium is as good or as much wanted as the gum, or the mucilaginous part, brandy is certainly the beſt menſtruum.

3. The gum of opium has the ſame taſte and ſmell with the juice; but the reſin has no taſte, and ſmells rather muſty than of opium. The remainder of the ſolution of opium in water is condemned in the Col. Chym. Leid. as void of any anodyne quality, and occaſioning great diſorders (a). But the extract with water mixed with ſome aromatics is commended by the ſame author as an innocent and excellent anodyne (b). The reſin is by Dr. Jones, &c. charged with all the ill effects of opium, but they ſhould have

(a) Maſſa tenax inſtar picis omnis fere odoris & ſaporis expers; quæ poſtea in ſpiritu vini tincturam ſuam deponit; at nullius fere uſus niſi in externis eſt. Fæces eodem reſtantes interno magnas anxietates circa præcordia efficere ſolent, ſine ullo doloris levamine. c. 310.

(b) Eſt anodynum optimum, quod nunquam anxietates circa præcordia, neque obſtructiones uteri, neque phantaſias conciliat.

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given more convincing evidences of the miſchief it does.

The ſolution of opium in water has all the good qualities of the juice, and operates in as ſmall a doſe, yet opium in ſubſtance is ſometimes preferable to it; if half of the ſulphur of opium only is reſin, one half of it is in all the aqueous ſolutions and extracts; a few grains of the moſt adheſive reſin, if not otherwiſe hurtful, cannot do much prejudice, much leſs the third or fourth part of a grain. The reſin of aloes has uſually been blamed for its violent irritation, but ſome endeavours have of late been made to prove it not only ſalutary, but the beſt correcter of the acrimony of the gum. As this might poſſibly be the caſe with opium, I made trial of a tincture drawn with alcohol from the extract made with water; it taſted ſtrongly of opium, and in the quantity of twenty-five drops proved ſomniferous, but without any bad effects. The balſamum anodynum of Bates proved anodyne internally as well as externally, although extracted with a rectified ſpirit. Crude opium may be in ſome caſes preferable to the ſolution, either as it does not ſo ſoon diſſolve, or on account of ſome ſingularity in the conſtitution. Hence I infer that the narcotic virtue of opium does not depend on its vaporoſum ſulphur (a), nor on its ſulphur craſſum admodum rareſcibile, akin to that of ſaffron, caſtor, &c. (b). Few vegetable ſubſtances have leſs ſulphur

(a) Frid. Hoffmannus de opiat. p. 151.

(b) Geoffr. M. M. tom. 2. p. 693, & 701. Sulphur craſſum quod in opio deprehenditur admodum rareſcibile eſt, ut liquet ex opii diſtillationibus, vehementi odore opii reſperſis: & ab hoc ſulphure condenſato, & ſummæ raritatis capaci ejus virtutem pendere exiſtimo. (Geoff. p 639, 693.) Quæret aliquis quænam ſint principia quibus opium hanc inſignem ſanguinis diſſolutionem & expanſionem excitare valeat? Cui reſpondeo, opium ſalibus tum acido, tum alcali urinoſo, & ſulphure craſſo plurimum condenſato, ſed ſummæ diviſibilitatis & expanſionis capaci componi. At vero non tam a ſalibus quam a ſulphure, ejus vim ſoporiferam pendere exiſtimo; quandoquidem obſervamus corpora ſimili ſulphure turgida, ut ſunt Crocus, nux moſchata, Caſtoreum, &c. in ſoporem inducere. Id. p. 701.

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than ſaffron (a). It yields all to water, nothing to oil. And it might be added that caſtor and aromatics are reckoned correctors of opium.

4. Though opium is rather alcaleſcent than aceſcent, yet it is not an alcali. For (α) ſpirit of vinegar, of hartſhorn, of vitriol, and oil of tartar, dropt ſeparately into a ſolution of opium in water in different glaſſes, cauſed no ebullition or efferveſcence; the acids only diluted the ſolution; but the alcali turned it milky, the mixture ſoon ſeparating into two parts; below it was clear and tranſparent as before, and the milky part gathered above like a thick cream. The ſolution with the oil of tartar in it ſmelt ſomewhat urinous. The cream ſeparated by filtration and dried, melted and flamed with heat, and diſſolved in alcohol, but not in water, and conſequently was part of the ſulphur of opium. To be more certain of this, I dropt oil of tartar and ſpirit of hartſhorn in ſeparate portions of a ſolution in water of the reſiduum, after extracting the reſin with alcohol, but neither of them cauſed any ſeparation or precipitation.

(β) A ſolution of opium in water made no change in an infuſion of violets, or tincture of ſaffron in water. A piece of blue paper thoroughly wetted with it, became, when dry, of a faded blue colour, rather greeniſh than reddiſh. It turned ſolution of turnſol in water of a bright red colour, and dried in a glaſs, continued a bright red. A ſolution of opium turned a ſolution of corroſive ſublimate milky, and curdled it. Upon the whole, the ſolution of opium gave more appearances of an alkali than of an acid, contrary to the account given by Mr. Geoffroy (b).

(a) Oleum eſſentiale croci nullibi extare legimus, Zwelf. Ph. Reg. 704. Crocus analyſi chymica perparum olei dat. Geoffroy. M. M. tom. 2. p. 284.

(b) Quod acidus ſal etiam in opio reperiatur, & quidem potens, probatur tum per analyſin; tum etiam ſi ſolutio opii in heliotropii tincturam affundatur; colorem enim rubrum igneum huic tincturæ conciliat. Geoff. M. M. tom. 2. p. 692.

(γ) The

(γ) The experiments α and β were tried with opium collected here, and likewiſe with the ſolutions of common opium in ſeveral menſtruums, with the ſame event, except where the menſtruum made a difference.

(δ) Oil of tartar dropt on crude opium, gave no ebullition or efferveſcence, and became whitiſh when dried, ſmelling ſomewhat urinous.

(ε) Blue vitriol turned a ſolution of opium milky, but the milkineſs ſubſiding the upper part grew tranſparent and of a beautiful green colour. Green and white vitriol turned it black, but made no change with a tincture of the heterogeneous ſubſtances which covered the opium. From theſe experiments it appears, 1ſt, that the eſſential ſalt of opium is ammoniacal; 2dly, that opium contains a very ſmall proportion of an acid; 3dly, that it is aſtringent, or makes the ſame change on chalybeats which vegetable aſtringents do.

In the fifth place, the moſt active principles of opium are very fixed; for it keeps well, and when forty years old remains hard, ſolid, and retains its taſte. One dram of freſh and pretty ſoft opium, kept in the heat of boiling water for five hours, ſcarcely loſt one grain and an half. Eight ounces of opium were fermented and diſtilled; the firſt four ounces which came over were hot to the taſte, and had a flavour different from that of opium; the ſecond four ounces were much weaker, and the laſt four almoſt taſteleſs. Upon rectification of the two firſt liquors, three ounces of a weak ſpirit, not proof, were obtained. The reſinous reſiduum which remained was full as much as if it had not been fermented, and retained a little of the ſmell of opium, but the extract had nothing of it. Hence, 1. opium is not the worſe for keeping. 2. The practice of toaſting opium in order to correct it by diveſting it of its narcotic part is of no ſervice. Wedelius ſays, if you ſeparate the narcotic ſulphur of opium, you ſeparate

its virtues (a). 3. Opium affords little or nothing by diſtillation.

In the ſixth place, opium yields upon a chemical analyſis phlegm, urinous ſpirit, oil, a volatile and a fixed ſalt, and ſome earth; but little of the virtues of opium can be inveſtigated or explained from its analyſis, ſince ſimples as different as poſſible as to their effects afford the ſame principles on diſtillation, as Mr. Homberg has ſhewn in the analyſis of deadly nightſhade and cabbage (b). Yet ſince ſeveral pretend to account for the effects of opium from its analyſis (c), the proceſs was repeated three times. Sixteen ounces of opium diſtilled in a retort with a gradual ſandheat, gave (α) of fœtid phlegm one ounce and two drams, which neither efferveſced with ſpirit of vitriol or oil of tartar, nor changed the colour of ſyrup of violets, but turned tincture of turnſole into a bright red; it alſo whitened and precipitated a ſolution of ſublimate.

(β) Of ſpirit four ounces and two drams, and of oil two ounces. The ſpirit was fœtid and acrid, and fermented greatly with ſpirit of vitriol; the oil was black and light, partly thick and partly thin.

(γ) A volatile ſalt adhering to the neck of the retort about four grains.

(δ) Of caput mortuum ſix ounces. Two ounces three drams and fifty ſix grains were loſt in the operation.

The method of eſtimating the volatile ſalt contained in this ſpirit, was by comparing it's ſtrength

(a) Mirum eſt quod authores nonnulli liberari opium contendant a ſulphure ſuo narcotico, cum tamen illam ipſam intendant, quærantque & expectant virtutem ex opio. Non caſtrandum eſt opium virtute narcotica, non ſulphur narcoticum ſeparandum; alias evanidum fiet, & nullarum virtutum; ſed heterogenea ſunt ſemovenda. Wedel. Opiol. p. 54.

(b) Vid. Homb. in M. Acad. R. 1701.

(c) Vid. Wedel. Opiol. l. 1. ſ. 1. c. 9. Pitcairnii Diſſ. de circul. ſang. p. 134. Geoffr. M. M. 2. 632.

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in ſaturating ſpirit of vitriol with ſalt of hartſhorn, whence it appeared to contain one hundred and fourteen grains of ſalt, ſo that the ſixteen ounces of opium yielded one dram, fifty-eight grains of volatile ſalt, and conſequently one grain from ſixty-ſix grains of opium. Hence, and from No. 4 and 5, it appears that the virtues of opium do not depend on it's volatile ſalt, or ſpirituous parts coagulating the blood, as ſpirit of urine does ſpirit of wine (a).

The caput mortuum by repeated calcinations was reduced to four drams, forty nine grains, and after the ſalt was extracted by boiling water, and the remainder dried, the earth weighed two drams, fifty one grains. The lixivium had a ſaline taſte, and neither efferveſced with ſpirit of vitriol or oil of tartar p. d. nor made any change in ſyrup of violets, tincture of turnſole, or ſolution of ſublimate. Upon evaporation, ſmall priſmatic cryſtals, neither alkaline nor acid, were obtained. The earth calcined for three hours loſt about ſix grains, and being waſhed and dried loſt twenty grains more. The remainder of the lixivium being evaporated gave about ten grains of a ſalt ſomething whiter than the former, and not at all alkaline: ſo of the calcined caput mortuum water extracted two drams, eighteen grains, which with the ſix grains loſt in the laſt calcination, ſubſtracted from four drams forty nine grains, gives two drams twenty five grains as the quantity of earth contained in a pound of opium. The quantity of ſalt is not equal to the ſubſtance diſſolved in the water, becauſe part of the lixivium was employed otherwiſe.

The proportions and quality of the ſalt and earth were much the ſame in all the three analyſes, except that in the ſecond there were obtained ſome ſmall priſmatic yellowiſh cryſtals, which appeared to be a true fixed alkali upon experiment. The paper grew moiſt in which it was kept, but it does not run per deliquium, to account for which requires ſome experiments. In the firſt analyſis the fire was ſlowly in-

(a) Vide Hoffm. Diſſ. de opiat. 143.

creaſed, in the ſecond the heat was raiſed as faſt as poſſible; in the third analyſis, the retort was kept in a boiling bath for a day, and then placed in a ſand-heat. The water obtained by the laſt proceſs was almoſt taſteleſs, ſmelt more of opium, and was leſs empyreumatic than that obtained by the firſt; it precipitated a ſolution of ſublimate, made no change in ſyrup of violets, but reddened tincture of turnſole. Hence opium contains but little acid, or a very weak acid, though Mr. Geoffroy is of another opinion.

A pound of opium yielded, according to Dr. Pitcairn, forty five drams of ſpirit, ten drams of oil, (β) ſixty two drams of caput mortuum, and ten drams were loſt in the diſtillation (β). According to M. Geoffroy, forty nine drams of ſpirit, nine drams of oil (β), ſixty two drams of caput mortuum; loſt ſeven drams, β, and the caput mortuum calcined to eight drams twenty five grains, yielded two drams twenty eight grains of an alkaline fixed ſalt, β, conſequently there remained ſix drams, ſix grains of earth, β, but by our proceſſes, forty two drams, ſix grains of phlegm, one dram fifty eight grains of volatile ſalt, ſixteen drams of oil, two drams eighteen grains of fixed ſalt, two drams twenty five grains of earth, and there evaporated in the diſtillation, perhaps of air, nineteen drams fifty ſix grains, and conſumed in calcination of oil, &c. forty three drams ſeventeen grains.

In the ſeventh place, the effects of opium on other animals are not much different from its effects on men, for it is to ſome of them at leaſt, hurtful, innocent or poiſonous, according to the doſe.

In the evening (α) a ſtrong frog was put into a pot of water wherein a ſmall quantity of opium had been diſſolved; it ſoon appeared to be uneaſy, but in a ſhort time made very little motion, and in the morning was dead and much ſwelled.

(β) A few drops of a ſolution of opium were conveyed into a frog's ſtomach by a glaſs tube, and the hinder foot of the animal was ſo placed before a microſcope

croſcope as to have a diſtinct view of the circulation of the blood in the membrane betwixt the toes. No alteration was perceived in the blood, as to it's conſiſtence, colour of the ſerum, magnitude, figure, or colour of the red globules, but it's velocity was ſurpriſingly diminiſhed. In about half an hour it regained it's common celerity, and the frog it's vigour. Upon giving the frog a ſecond doſe, the blood moved ſlower than it did the firſt time, and it's velocity gradually decreaſing, ſtagnated firſt in the ſmaller then in the larger veſſels, and in a quarter of an hour the frog expired. It is worthy of remark, that notwithſtanding the diminution of the velocity of the blood, the pulſe was not leſs frequent, and that even when the circulation ſtopt in the foot, the pulſe remained viſible by an undulatory motion. Upon opening the frog, it's ſtomach was found full of a clear mucus tinged with the opium, every thing elſe ſeemed perfectly natural. This experiment was repeated ſeveral times with the ſame appearances.

(γ) Half an ounce of opium diſſolved in four ounces of water, filtrated and warmed, was injected at three times into the crural vein of an old dog of forty two pound weight; fifteen drams were ſlowly injected at firſt without any obſervable effect; an hour after, eight more were alſo ſlowly thrown in, and immediately the dog was ſeized with ſtrong convulſions, the pulſe grew frequent and ſmall, and after ſome time he foamed at the mouth; about an hour after nine drams more were thrown in; upon which the pulſe became full and ſlow, and in a minute or ſo the dog expired. On opening his thorax his lungs were found ſound, but very ſmall and white without any blood in them. The heart was big, and all it's great veſſels diſtended with blood. In this ſtate they continued till next day, when, on opening them, clotted blood run out from the right ventricle, and vena cava, the blood in the left ventricle and aorta being much more coagulated. But nothing was obſerved preternatural in the brain or abdomen.

(*δ*) A dog of about fifteen pound weight had two drams of opium given him wrapt up in a crum of new bread, which he ſwallowed immediately. No alteration was perceived in an hour, but next day he had loſt the uſe of his limbs, and would neither eat nor drink. In this ſtate he continued four days, and then recovered. The ſame quantity of opium diſſolved in boiling water had more ſudden and more fatal effects on the dog mentioned by Dr. Mead, in his eſſay of opium.

In the eighth place, opium externally applied is diſcutient, anodyne and ſoporiferous; and has almoſt the ſame effects as when taken inwardly. One of the inconveniencies following the immoderate application of opium, mandragora and hyoſcyamus, for pains of the eyes, taken notice of by Galen (a), is the mydriaſis, or a preternatural dilatation of the pupil. Mr. Ray gives a notable inſtance of this kind; a woman having applied part of a leaf of the deadly nightſhade (b) to a cancerous ulcer a little below her eyes; in a night's time the uvea loſt entirely it's muſcular force, and was ſo relaxed that the pupil, in the cleareſt light, remained four times bigger than that of the other eye. But on removing the leaf, the tunica uvea recovered it's former tone by degrees (c).

Opium externally applied gives eaſe in ſundry pains. But that it can make any part inſenſible of pain is not ſo evident. Wedelius declares he could never obſerve any ſuch effect (d).

(*α*) Nor did I perceive that applied by way of plaiſter, it either ſtupified or inflamed the part. (*β*) The ſolution of it applied to ſuperficial wounds proves al-

(a) Solanum lethale. Park.

(b) Method. med. l. 3. c. 2.

(c) Et ne quis caſui imputet, tribus diſtinctis vicibus in ſe ipſa experta eſt me quoque tunc temporis forte fortuna præſente & ſpectante; chirurgus qui cancrum eradicaverat, & ulcus ſanaverat folii particulam loco impoſuit ad humores repellendos; verum ad ſymptoma prædictum eandem removere coactus fuit. R. H. p. 680.

(d) Nos nunquam ſtuporem partis ab impoſitione opiatorum obſervare potuimus. Opiol. l. 2. § 3. c. 1.

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ways hot and irritating. Hence it appears that opium externally applied is not narcotic, and that narcotics may impair the tone of the mufcles, and caufe for a time a palfie about the place to which they are applied.

In the ninth place, opium rather coagulates than attenuates the blood. A folution of it mixed with milk at firft makes no alteration, but after fome days a white grumous part fubfides, a cream fwims a-top, and the liquor between grows clear and of the colour of the folution. The folution turns the ferum of the blood more thick and whitifh; it has the fame effect on blood frefh drawn, and always precipitates a whitifh coagulum. Sydenham's laudanum made the blood from a vein appear more crimfon-coloured, but next day it was darker; there was a greyifh precipitation, and the upper part was not coagulated, perhaps becaufe fhaken and diluted by an incoagulable liquid. Thefe trials agree with Dr. Freind's experiments (a), and favour what is affirmed by fome authors, that the blood has been found congealed or froze, as they exprefs it, about the heart of fuch as have been killed by opium (b). There was grumous blood in the upper part of the brain of the dog which Dr. Mead (c) mentions.

In the tenth place, ufe makes that quantity of opium fafe, and even beneficial, which would otherwife prove poifonous. Daily experience confirms this, and they that habituate themfelves to opium find it as neceffary as fpirituous liquors to tipplers. A few grains will deftroy a perfon unaccuftomed to it, but fome diforders, as madnefs, enervate its force. A much fmaller quantity than even the ufual dofe may prove mortal. A corpulent woman forty years of age after having been liberally blooded one day took the next by miftake about one third of the following mixture, which fhe had generally applied as a liniment for the piles. Myrrhæ drach. ii. opii drach. i. ol. rof. coct. unc. fem.

(a) Emmen. c. 14.
(b) V. Wedel. Opiol. l. 1. § 1. c. 5.
(c) Mech. account poif. p. 152.

In about three quarters of an hour the muſcles were ſo paralytic that ſhe could ſwallow nothing, her face was pale, ſhe could not ſpeak, and appeared like one very drunk, her pulſe was large, equal, and not very frequent, at length it ſunk, intermitted, and ſhe died without any convulſions. On the other hand, among the eaſtern nations, a dram of opium is but a moderate doſe; Garcias knew one who every day took ten drams, and though he always appeared ſtupid and ſleepy, yet he diſputed very readily and learnedly on any ſubject (a). And it is remarkable. that notwithſtanding this exceſſive uſe of opium, the Turks are generally long lived (b).

In the eleventh place, the action of opium is very analogous to that of wine or vinous ſpirits. For 1ſt wine is the beſt remedy for the inconveniencies following on the diſuſe of opium. Acoſta gives a memorable inſtance of this; and Proſper Alpinus's obſervations among the Egyptians confirm it (c).

2dly. Both the good and ill effects of opium differ little from thoſe of wine. Wedelius may be conſulted on this head, and Mr. Geoffroy in his Materia Medica. Angelus Sala obſerves, that the abuſe of wine is proved by the teſtimony of all authors, and experience itſelf, to produce, in the proceſs of time, the phrenſy, lethargy, palſy, and other terrible ſymptoms, as well as opium (d). Vinous ſpirits applied externally, remove in an inſtant the pain of burnings, if the cuticle be not ſeparated. And 3dly, vinegar is as much an antidote to opium, as it is to wine; no

(a) Et licet ſtupidus & dormitabundus ſemper videretur, aptiſſime tamen & doctiſſime de omnibus diſputabat. l. c.

(b) Vide Bellon. lib. 3. obſ. 14, 15.

(c) Animi ſiquidem deliquio faſtidioſiſſimo ipſi tentantur, nulloque auxilio ſic tuto liberantur, quam rurſus opium devorantes—— multos ab hac ſervitute liberatos vidi, ſi in hora, qua ſoliti ſunt ipſum capere, largius ex vino Cretico, pipere atque aliis aromatibus alterato potent. Med. Æg. l. 4. c. 1.

(d) Secundum omnes authores, atque ipſam experientiam, ab uſu phreneſin, maniam, rabiem, furorem, ſtupiditatem, lethargiam, paralyſin, aliiſque deteſtandos effectus temporis ſucceſſione parit non minus quam opium. Opiol. c. 3. p. 531.

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wonder then that Platerus (a) ſhould affirm wine to be a real narcotic, and Sydenham (b) that opium is the moſt excellent cordial in nature. Hence wine cannot be ſaid to correct opium, nor can opium be ſaid to act by rarifying the blood, ſince ſpirits which coagulate it, produce much the ſame effect.

In the twelfth place, the virtues of opium internally taken depend chiefly on it's action or influence on the ſtomach. I have often obſerved a violent teneſmus removed in a moment by a few drops of liquid laudanum, vomiting ſtopt, pain eaſed, and ſleep procured the ſame way, and almoſt as ſoon. There are many inſtances (c) of terrible ſymptoms, and death itſelf cauſed by narcotics before they went out of the ſtomach, and without inflaming it or undergoing any viſible change in it, far leſs vitiating the maſs of blood; and alſo of the ſame ſymptoms being removed, and death prevented by vomiting.

Several other præcognita might be here inſiſted on, as that 1ſt, in pain there is a preternatural contraction of the ſenſile fibres, and in ſleep a relaxation of the organs of ſenſation and voluntary motion. 2. The moſt inconſiderable or minute mechanical impulſe on the nerves, or unuſual impreſſion on the mind, may be the cauſe of the greateſt changes in the animal œconomy. 3. The virtues of many medicines depend ſolely on their action on the nerves, or nervous fibres. 4. The ſame force or impreſſion on the nerves of one part has very different effects from what it has on the nerves of another, and often at one time from what it has at another time on the ſame part, e. g. aſarum in the noſe and in the ſtomach, tobacco at firſt and after it is habitually uſed. 5. This action on the nerves being many times no otherwiſe diſcoverable than by its conſequences, the primary and ſecondary effects of medicines may be and are too often confounded. And, 6. As the primary effects of a medicine have ſeveral ſecondary ones, ſo the ſame ſimple

(a) Queſt. Therap. 88. & 89. (b) Sect. 4. c. 3.
(c) Wepfer. de cicuta aquatica.

ple ſometimes differently affects the ſame nerve, or at leaſt different nerves of the ſame part, ſo as to produce effects altogether independent of one another; this our taſte in many inſtances can diſcover, and the taſte of opium, compared with that of many other narcotics, ſufficiently evinces it to be the caſe here; that is, that the ſtimulating qualities of opium have very different effects from the narcotic part; and if we compare the effects of wholeſome aromatics with thoſe of the moſt virulent narcotics, we may add,
7. That the ſtimulating or aromatic part of opium is ſo intimately united to the narcotic, as thereby to mitigate it and render it more friendly to nature, than the narcotics which want it are. I ſhall conclude this ſection with a few inferences from the whole.

1. That the anodyne and hypnotic virtues of opium do not depend on it's action on the brain or on the blood.

2. That it affects firſt and principally the nerves to which it is applied; next ſuch as more immediately communicate with them; then thoſe which ſerve for ſenſation and voluntary motion; and laſt of all, by conſent, the whole nervous ſyſtem.

3. That this impreſſion on the nerves differently affects the ſenſorium commune and the mind, according to it's degree, and the nature and function of the nerves primarily acted upon.

" Theſe who take a moderate doſe of opium, eſ-
" pecially if not long accuſtomed to it, are ſo tranſ-
" ported with the pleaſing ſenſe it induces, that they
" are, as they oftentimes expreſs themſelves, in hea-
" ven; and though they do not always ſleep, yet
" they enjoy ſo perfect an indolence and quiet, that
" no happineſs in the world can ſurpaſs the charms
" of this agreeable extaſy(a)." Which therefore, cæteris paribus, muſt remarkably promote a free circulation and perſpiration, and by removing impedi-

(a) Mead of opium. p. 146.

ments

ments difpofe to fleep (a). But if the dofe be immoderate, and the impreffion exceeds the bounds prefcribed by nature, as in drunkennefs, thefe tranfports of joy degenerate into ridiculous mirth, deliriousnefs, &c. or end in profound fleep, lethargy, &c. or a palfy, apoplexy or fudden death finifh the tragedy; whereas the effects of opium in the mouth and nofe, or parts fore or excoriated, &c. are very different, as has been formerly obferved. The anodyne virtue of opium externally applied therefore cannot be the effect of any delightful fenfation in the part; pleafure may well be the confequence, but it does not appear to be the caufe of the removal of pain.

4. That the primary or firft obfervable effect of the mechanical impreffion of the narcotic part of opium on the nerves is the relaxation of their fibres.

Now as this relaxation of the nerves, and confequently of the moving fibres demonftrates opium to be more than a palliative remedy in a great many difeafes; fo it is not difficult by it to account for its bad as well as good effects; for by relaxing to certain degrees it may prove anodyne, cordial, diaphoretic, hypnotic, &c. or caufe ftagnations, deliriums, lethargies, apoplexies, death.

The mention of opium's rarifying the blood has been hitherto purpofely omitted, not only becaufe it appears to have no fuch effect, at leaft that the operation of opium cannot depend on it; but alfo becaufe were this theory admitted it might lead into dangerous errors in practice, e. g. if rarefaction of the blood be admitted as the caufe of the direful fymptoms which the abufe of opium fometimes occafions, the remedy indicated would be venæfection, which fome authors affirm to be death even the day after a narcotic has been taken; and poffibly the woman whofe cafe is

(a) Pericharia corpora efficit leviora, lætitia diaftolen & fyftolen efficit faciliores, mœftitia difficiliores. Nihil magis reddit liberam perfpirationem quam animi confolatio, lætitia moderata infenfibiliter evacuat folum fuperfluum, immoderata fuperfluum & utile. Sanct. Aphor.

men-

mentioned (no. 10.) having been the day before liberally blooded was one reaſon of ſo ſmall a quantity of opium's proving ſuddenly mortal. Beſides, if it rarified the blood, how could it be uſeful in hæmorrhages, ſmall-pox, &c.

Opium does more honour to medicine than any remedy whatſoever. What could a phyſician do without it in many diſeaſes, as in violent pains, want of ſleep, exceſſive evacuations, choleras, dyſenteries, diſorders of the nerves, &c.? How beneficial is it in various fevers, gravel, gout, cough, conſumption, &c.? In a word, though opium is not a panacea, yet there are few diſtempers in which it has not been ſometimes given with ſucceſs (a).

SECT. IV.

Opium is commonly given to adult perſons unaccuſtomed to it from half a grain to three; but, to ſuch as uſe to take it, to four, five or more grains, till it produce the deſired effect. The uſual preparations are the extract, tincture, Sydenham's liquid laudanum, anodyne balſam, and pacific pills; and it is the baſis of the ſtorax pills, mithridate, theriaca, diaſcordium, &c.

With relation to the doſe, it is ſafer to give too little than too much of opium, eſpecially ſeeing its effects appear ſo ſoon, that the defect can be more eaſily ſupplied than the exceſs remedied. For if too much opium is taken, the muſcles become ſoon paralytic, ſo that nothing can be ſwallowed, and all we can do is to endeavour to provoke vomiting by tickling the throat, or by clyſters and cataplaſms of tobacco, and ſuch emetic applications, and at the ſame time to rouſe nature by ſtrong ſinapiſms, &c. If thus the patient is enabled to take medicines, after empty-

(a) Ita neceſſarium eſt opium in hominis periti manu organum, ut ſine illo manca ſit & claudicet medicina; qui vero eodem inſtructus fuerit, majora præſtabit, quam quis ab uno remedio facile ſperaverit. Sydenham.

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ing the firſt paſſages, diaphoretics mixed with vinegar, and ſuch like acids, ſeldom fail to complete the cure.

Extractum opii or opium præparatum, off. is opium diſſolved in water, filtred and evaporated to the conſiſtence of honey (a). Our college direct the ſeparation of the heterogeneous ſubſtances, and part of the roſin. This extract, if brought to the conſiſtence of opium, is about a fourth part ſtronger than crude opium itſelf.

Tinctura opii or laudanum liquidum, off. is a ſolution of one part of crude opium in ten parts of zerry filtrated.

Laudanum liquidum Sydenhami, off. differs from the former in being aromatized with ſaffron, cloves and cinnamon, which rather increaſe than diminiſh its virtues. The balſamum anodynum Batæi, off. is a tincture of opium, ſaffron, &c. in rectified ſpirit of wine, and is an uſeful medicine in many caſes, both externally and internally applied.

Pilulæ pacificæ, vulgo Matthæi, off. with both the hellebores, gained great reputation abroad as well as at home (b). Bates ſays, ſome diſlike the black hellebore; Quincy leaves out the white, and our college rejects both; they are both too reſinous to be eaſily diſſolved in the ſtomach. There is a grain of the extract of opium in about ten grains of the pilulæ Matthæi Batæanæ & Edinburgenſes; in eleven grains of this pill according to Quincey's diſpenſatory; and in nine grains of our pilulæ e ſtyrace.

It is obſerved by Geſnerus, Platerus, &c. that the mithridate without opium is not ſudorific. If this be true of this compoſition, whereof half an ounce does not contain one grain of opium, much more muſt it be

(a) Opium non coctum longe promptius ſomnum movet, & dolores mitigat, quam ſi diuturna coctione vaporabili ſuo principio orbatum fuerit. Hoffman, de opiat. p. 128.

(b) Magnæ famæ remedium——quod, uti ſæpius animadvertimus, alvum ſolutum præſtat, ſudorem efficaciter movet, & nunquam facile torporem gravativum, ſicuti ſibi relicta opiata efficiunt, poſt ſe relinquit. Hoffman, opiat. 139.

be ſo of another framed after the ſame model, and not otherwiſe materially different, viz. the theriaca Andromachi, of which at leaſt ſeventy ſix grains contain one grain of this juice. The ſame may be ſaid of the trypheras, philoniums, orvietanums, and the like numberleſs ſeſquipedalia antidota, with which authors both ancient and modern too much abound.

To conclude, opium is an edged tool, and may do hurt; but it is alſo a divine remedy, and may do much good. A phyſician may be too timorous as well as too bold in practice, and the ſick oftentimes ſuffer the one way as well as the other. As therefore I ſee no reaſon abſolutely to condemn the giving of opium to infants, to weak, plethoric, or aged perſons, to pregnant women or in malignant diſeaſes; ſo on the other hand, if removing pain, procuring ſleep, checking evacuations, preventing a ſalutary hæmorrhage, or the like, be dangerous or unſafe; he muſt either be ignorant of the methodus medendi, or of the nature of opium, who in ſuch caſes raſhly preſcribes it.

Method of preparing an extract and ſyrup of poppies, by Mr. THOMAS ARNOT, *Surgeon in* Cowpar. Vol. 5. art. 11.

THE extract of Britiſh poppies is in ſome caſes preferable to the opium brought from Turky. In order to obtain it to the greateſt advantage the culture and management of the poppies are to be taken care of. Chuſe the ripeſt and whiteſt ſeed of the great ſingle flowered Turky poppy, ſow it in March very thin and ſuperficially in drills at two feet diſtance each. The ſoil ſhould be rich and freſh, for by continuing the poppies ſeveral years on the ſame ground, they degenerate. As the young plants ſpring up, all but the moſt thriving are to be taken away. When the heads of theſe are come to their full growth, but before they are ripe, chuſe a calm, warm, ſunſhine day

 to

to cut off ſuch as are full-grown, at an inch from the top of the ſtalk, going backwards along the rows to ſave the milky liquor which riſes to the cut part, from being ſpilt by your clothes, Let all the heads lie in a baſket till the liquor which runs out of them thickens, and is thereby ſaved. Two or three days after lop off ſuch other heads as are large enough, and at the ſame time cut off pieces of three inches length from the ſtalks of thoſe formerly cut. This lopping and cutting is to be repeated till no more juice riſes in the ſtalks. After the heads and ſtalks are dried, cut and bruiſe them, and infuſe them in hot water for ſome hours; then boil them for four hours; ſtrongly expreſs the liquor, and after it has ſtood ſome days to ſubſide, clarify it with whites of eggs and evaporate it to the conſiſtence of honey or of an extract. Out of five or ſix pounds of dried heads and cuttings, I have had a pound of extract. This muſt be given in double the quantity of Turky opium to anſwer the ſame intentions; which it effects, without inclining patients to deliriums or occaſioning a nauſea and giddineſs, the uſual conſequences of the other. This I attribute to the groſs and viſcous parts being ſeparated by ſubſiding and clarification. Syrup of poppies may be made with this extract to greater advantage than from the poppies themſelves, and will keep better, for it does not ferment in warm weather or upon being moved. And it is preferable to the other becauſe it's doſe may be exactly determined while the ſtrength of the other is very uncertain, ſince different poppies have different proportions of the narcotic juice. In making it, I diſſolve two grains of the extract in one ounce of ſyrup. The decoction boiled to the conſiſtence of honey is nearly half as powerful as the extract, and is kept to ſave the time and trouble of diſſolving opium or the extract, when preſcribed in electuaries, &c. where the opium requires to be intimately and equally mixed with the other ingredients of the compoſition.

The bad effects of opium given too ſoon to ſtop the operation of emetics. By Mr. JOHN STEDMAN, *Surgeon in Kinroſs.* Vol. 4. art. 6.

A Gentleman, aged forty-nine, took ſix grains of emetic tartar, which after vomiting him ſix or ſeven times, began to purge him with gripes. Growing impatient, he took twenty drops of laudanum in a glaſs. In half an hour after taking it, he was free of the gripes and purging, but in half an hour more, became ſhort-breathed, with ſweating about the heart; but before any thing could be done for his relief, he died.

An eſſay on extracting the acid of ſulphur, by CHARLES LUCAS, *of the city of Dublin, Apothecary.* Vol. 5. art. 14.

THE uſual methods of preparing the acid ſpirit of ſulphur, or oil of ſulphur by the bell, as it is called, are ſo tedious, troubleſome and expenſive, that few are at the pains to make it. Both the methods deſcribed by Mr. Charras (a) are liable to many uncertainties and inconveniencies, as well as that recommended by Mr. Homberg (b).

After ſeveral trials I invented the following method, which fully anſwered my expectations. The apparatus is delineated in Plate II. conſiſts of,

1. A gallon retort A, with a wide neck B, and a hole C, ſix inches diameter cut in the bottom of the bole D.

2. A large receiver E, with a ſpout F.

3. A crucible for burning the ſulphur in G.

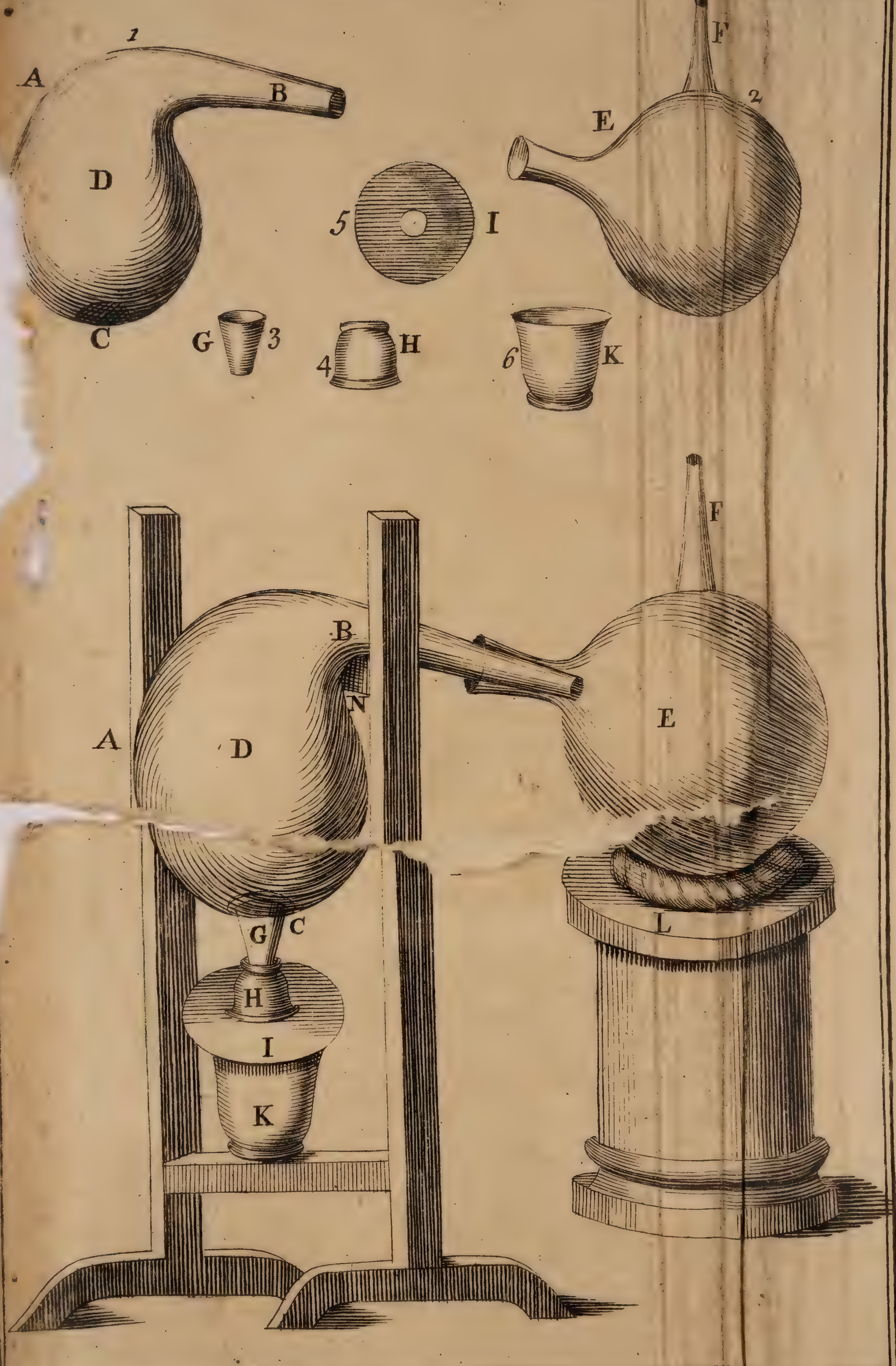
4. A flat bottomed gally-pot H.

5. A concave glaſs I, perforated in the middle i.

Theſe I place in the order expreſſed in the figure, thus.

(a) Pharmacop. Royal. p. 883.
(b) Mem. de l'acad. an. 1703. p. 39.

p.161. Vol.1. Plate II



Having adapted the receiver to the retort, I place it upon a round L, with the ſpout upwards, ſuſpending the retort by the neck, lodged in a nich N, of the frame M, with it's neck inclining ſo much to the receiver, that the drops may juſt fall into it.

The glaſs mortar K is placed under the orifice C, of the retort A, and is covered with the concave plate I, with the gally-pot H, inverted on the perforation in the plate. Upon this I ſet the crucible G, with about three ounces of flowers of ſulphur in it. The ſulphur is fired by throwing a lighted coal into it, and then the glaſs mortar K is gradually raiſed, till the crucible G is juſt received within the orifice C. When the ſulphur is conſumed, I put in the ſame quantity of new lighted ſulphur in another crucible, and thus proceed till as much of the acid is obtained as is required.

In this proceſs it is obſervable,

1. That it is neceſſary to bedew the glaſſes with the ſteam of boiling water, before you ſet fire to the ſulphur.

2. That the operation ſucceeds beſt in calm, ſtill, wet weather, and in a damp place; in dry weather the defect of the moiſture of the air may be ſupplied by conveying the ſteam of boiling water to the orifice in the boll of the retort; afterwards the liquor may be dephlegmated to any degree of ſtrength by evaporation.

3. That by the make and poſition of the glaſſes the acid fumes are conſtantly riſing into them, inſomuch that they ſoon grow opaque with clouds, which in a ſhort time condenſe and trickle down the ſides of the glaſſes in drops.

4. That the ſulphur has air enough to burn clearly; for want of which the acid would be ſpoiled by a great quantity of white fuliginous matter, which would be elevated and ſtick to the ſides of the glaſſes.

It is extremely difficult to calculate the proportion of acid, which a given quantity of ſulphur yields; but from the moſt moderate computation, a pound of

flowers of ſulphur, which may be burned in about ſeven or eight hours, will yield about ſeven drams, or an ounce of pure acid *(a)*.

In this proceſs I uſe the flowers inſtead of crude ſulphur, for the following reaſons, 1. I cannot find by any experiment that ſublimation diveſts the flowers of any part of the native acid of the ſulphur: if it did, ſublimed ſulphur (that is, flowers) would no longer retain the natural form, nor indeed any of the characteriſtics of mineral ſulphur; and we find that the reſiduum after ſublimation of pure mineral ſulphur, is no more than a ſimple, inſipid, argillaceous earth.

2. As the crude mineral is often tainted with metals, and ſuch like foreign matter, ſo it is highly probable that ſome particles may be elevated in burning, which might otherwiſe have eſcaped the ſubliming heat; and conſequently the acid extracted from crude ſulphur, may not be ſo ſimple and homogene as that from the flowers of ſulphur.

3. Moreover crude ſulphur will not burn clearly without frequent agitation, which is both tedious and irkſome; and I could never find any ſo pure as to yield an equal proportion of acid with the flowers.

I ſhall conclude this eſſay with a few remarks on ſome aſperſions which have been thrown on this acid of ſulphur. The firſt prejudice raiſed againſt it was by Dr. Stahl (b), who ſays it does not præ-exiſt in the ſulphur, and that it is a creature of the fire *(c)*. But

(a) The quantity of acid liquor greatly varies with the weather, being conſiderably more in moiſt than in dry weather. The purity of the acid muſt correſpond with that of the air of the place in which it is made.

(b) Fundam. Chemiæ Dogmat. Experiment. p. 96, & ſeqq.

(c) The author certainly miſtakes Dr. Stahl, who expreſly ſays, that ſulphur is compoſed of an acid ſalt, and the inflammable principle, in the following words. "Firmius interim videtur ex "acidi ſalis formali concurſu oriri ſulphuris concretum, & error in "eo latere videtur, quod in experimentis combinationis bituminum cum acido & exinde reſultante concreto ſulphuri per omnia "æmuli credatur, bitumen ſeu reſinam quoad totam ſui ſubſtantiam ad combinationem hanc concurrere, cum tamen eis "ſaltem principium ſeu pars conſtitutiva quædam non integrans "mere pro hoc opere requiratur." Stahl. loco ſupra citato.

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the contrary of this is demonſtrable various ways; for, 1. Copper or iron ſtratified with ſulphur are in a ſhort time corroded, and may by that means be converted into vitriol. 2. Plain flowers of ſulphur are not at all affected with rectified ſpirit of wine, but upon the predominant acid's being overcome by a mixture of an alcaleous ſalt, the ſulphureous parts readily diſſolve in it. Here it is obſervable, that the terebinthinated balſam of ſulphur, as commonly made, is but little better than an empyreumatic oil of turpentine; but if made with hepar ſulphuris inſtead of the ſimple flowers, it acquires a ſtronger and deeper impregnation and colour, and a better conſiſtence. Sulphur may be made by combining a fat, oily, or bituminous ſubſtance, with any mineral acid ſalt *(a)*; and this is found to produce a maſs in every reſpect anſwering the characteriſtics of common mineral ſulphur. From all which it may be inferred, that the acid præ-exiſts in ſulphur.

Some are of opinion, that all mineral acids differ only according to their degree of ſtrength. This may hold good primogenially conſidered, but it is demonſtrable that all mineral acids differ conſiderably with regard to the minerals they are extracted from.

1. The acid drawn from venereal vitriol is of a dark-brown colour, and of a more auſtere taſte than that drawn from martial vitriol. Since then all imperfect metals or metallics contain ſome parts which may be elevated by the fire, and the acid of vitriol can only be ſeparated by a moſt intenſe degree of heat, it may be ſuppoſed to contain ſome particles of the metal or metallic in it. 2. Hence it probably is, that

(a) The difficulty of making ſulphur with every acid is very great, if not inſuperable: with the vitriolic acid indeed the inflammable part of bodies eaſily combines into a true ſulphur; but there does not appear to have been found out any way by which the marine or nitrous acid may directly be combined into ſuch a ſubſtance. Stahl is expreſsly of this opinion. "Accipio (ſays he) "itaque acidum, & quidem vitrioli aut ſulphuris. Non nitri aut "ſalis communis, quia hæc duo ſalia, mixtione nova & tenuiſſima "(e ſulphuris ſeu vitriolico acido & alia ſpecificata ſubſtantia) ſpecificate adeoque ad hanc novam mixtionem ſubeundam, eo ipſo, "quod

that Hoffman (a) obſerves, that preparations of iron made with the acid of vitriol are rough and diſagreeable to the ſtomach, but with the acid of ſulphur ſweet and grateful. At the ſame time he allows that the difference between the acids is accidental, that of vitriol being more groſs, impure and terrene; but that of ſulphur more pure and homogene: which opinion Boerhaave (b) ſeems to favour. From this the weakneſs of their aſſertion appears, who ſay that one is a ſulphureous ſpirit of vitriol, and the other a vitriolic ſpirit of ſulphur.

The further diſparity of mineral acids is experimentally illuſtrated by Borelli (c), to whoſe experiments on live dogs, with the acid of ſulphur, nitre, &c. I refer the reader.

There appears therefore an eſſential difference between the acid of ſulphur, and it's too frequent ſuccedaneum, that of vitriol *(d)*.

" quod jam aliter mixta ſunt, inepta exiſtunt." Stahl. Opuſc. " Chym. Phyſ. Med. 4to. Hal. Magdeb. 1715. p. 313.

(a) Clavis Pharmaceut. Schrod. p. 373.

(b) Elem. Chym. tom. 2. proc. 151.

(c) De motu animal. p. 11. prop. 224.

(d) The author of the Pharmacopœia Reformata is of opinion, that the difference of the two acids is not eſſential, but merely accidental. " There have been ſeveral experiments (ſays he) to " ſupport the contrary opinion; but if the two acid liquors be " reduced to the ſame ſtrength, and perfectly freed from all hete- " rogeneous ſubſtances, they will be perfectly ſimilar, and not to " be diſtinguiſhed." Eſſay for Reformation of the London Pharmacopœia, London 1744. p. 64.

There are two more elegant and facile ways of extracting the acid from ſulphur than that here delivered; although it muſt be admitted that the author's is really an improvement on the common methods. The firſt is by Stahl (Exper. obſervat. animadverſ. Et in Opuſc. chym.) who directs woollen clothes to be moiſtened in a ſolution of fixed alkaline ſalt, and then dried. Theſe are to be ſuſpended over the fume of burning ſulphur, which will be imbibed and locked up in the ſalt, from which it may be eaſily ſeparated by the addition of oil of vitriol, and the aſſiſtance of common glaſs diſtilling veſſels. The ſecond is by Mr. Seehl (Improvement on making volat. ſpirit of ſulph. By Ephr. Rinh. Seehl. Lond. 1744.) who pours oil of vitriol on a hepar ſulphuris placed in a glaſs retort, to which he adapts a receiver, and by a ſmall heat draws off the acid liquor.

Remarks on the neutral ſalts of plants, and on Terra foliata Tartari. By Dr. JOHN FOTHERGIL, *Phyſician at London.* Vol. 5. art. 13.

THERE is a particular kind of neutral ſalt in the aſhes of vegetables, which is uſually extracted along with the pure alkaline ſalt, and which renders it unfit for ſome purpoſes; of this the following is an inſtance. A chemiſt attempting to prepare the terra foliata tartari, made uſe of a lixivial ſalt drawn from fern aſhes, which was ſaturated with about eight or nine times it's weight of ſtrong diſtilled vinegar, although pure fixed alkali requires fourteen or fifteen times it's own weight. When the liquor was evaporated to the conſiſtence of honey, it hiſſed and crackled where it hardened on the ſides of the veſſel, ſhewing hardly any marks of a diſpoſition to flow, which uſually happens, when a pure alkaline ſalt is employed. Several attempts to make the proceſs ſucceed were without effect. Suſpecting the neutral ſalt to be the cauſe of the failure, the refractory maſs was diſſolved in warm water, and ſet to cool; a large quantity of neutral cryſtals ſhot, chiefly of a cubical form, variouſly joined together, and intermingled with ſalts ſurpriſingly figured; great part of the ſalts appeared to be marine from their figure, taſte, and from experiments; the reſt were partly a ſal polychreſt, and partly the eſſential ſalt of the plant. The operation was repeated ſeveral times, before a ſalt was obtained which flowed and foliated. The cryſtals were more bitter and pungent than the firſt, though in figure alike; the terra foliata did not flow nor foliate ſo freely, nor were the foliations ſo large or ſo white as uſual.

The chemiſts uſe pot-aſhes *(a)* for this preparation, and

(a) Pot-aſhes, cineres clavellati. Some ſorts of theſe have been found to contain a large quantity of ſea ſalt, which is probably

and with better ſucceſs than any other lixivial ſalt; the reaſon of which ſeems to be, becauſe in preparing pot-aſh cold water is run through the aſhes only till it has extracted the more ſoluble parts of them, by which means the neutral ſalts are left behind, and probably in drying the lixivium, what neutral ſalt is in it is forced by the fire to the ſurface, and forms a cruſt: that the aſhes which remain contain neutral ſalts in them, is evident from their uſe in agriculture. In making the foliated tartar, the more vinegar is put to it, the larger and whiter will the leaves appear, and leſs liable to be alkaline or corroſive, although more expenſive; for little more ſalt will be obtained than the weight of the alkali made uſe of. This is perhaps the only one of the neutral ſaponaceous ſalts which is the more efficacious the whiter and purer it is. This medicine taken from the quantity of half a dram to two drams is an excellent alterative and diuretic, and from three to ſix drams a mild cathartic, which never ſinks the ſpirits, or occaſions any violent diſorder. Of it's ſervice in dropſies the following caſe is an inſtance.

A married gentlewoman, 48 years old, childleſs, a little corpulent, was repeatedly affected with an immoderate diſcharge of the menſes; ſoon after her belly began to ſwell, her legs grew œdematous, all the ſymptoms of a dropſy appeared. She was treated with ſtrong and gentle cathartics, diuretics, aperients and corroborants; but this bad circumſtance always attended evacuants, either by ſtool or urine, that they never failed to produce a diſcharge of blood from the vagina, which ſunk her prodigiouſly. Corroborants, eſpecially of the aſtringent kind, ſoon ſtopt the flux, but at the ſame time contributed to increaſe the ſwelling, by leſſening the diſcharge by urine and ſtool. She then began to take three drams of the terra foliata tartari once or twice a week; it gave her

bably mixed with them by the makers, not only as it is much cheaper, but as it makes them whiter, and more eaſily run into large maſſes.

two

two or three ſtools, with a large evacuation of urine, without exciting the menſtrual diſcharge, or affecting her ſtrength; ſhe continued the uſe of it for upwards of a year, without increaſing the doſe, or attempting any other relief than what that gave her, which was very great. Whether it would have made a compleat cure, I cannot ſay; for having taken a rough purgative, ſhe had her days ſhortened by it.

An eſſay towards aſcertaining the doſes of vomiting and purging medicines, by Dr. CHARLES BALGUY, *Phyſician at Peterborough.* Vol. 4. art. 5.

THE art of adjuſting the doſes of medicines to the age, ſize and ſtrength of the patient, ſo that he ſhall receive the moſt ſpeedy and certain relief which the medicines are capable of giving, without the hazard of injuring the conſtitution, although of the utmoſt conſequence, is little underſtood. Dr. Cockburn attempted ſomething of this kind, but on wrong principles. The method I ſhall offer is liable to objections, but it is better than none. It will be granted, that 1ſt, Part of the medicine is ſpent on the firſt paſſages, where it acts as a ſtimulus; and, 2d, The other part is carried into the blood, and has it's effect there by thinning and rarifying it. The firſt is plain from the acrid burning taſte, and the bliſters which the moſt powerful occaſion in the mouth; the other from the pulſe being raiſed after taking them, and from known experiments upon the blood. Could the force of theſe medicines be determined, the doſe might be ſo too; but all that can be done is to aſſign ſuch a proportion as is moſt agreeable to experience. The reſinous purges act chiefly on the firſt paſſages, thoſe of a more lax texture are carried into the blood, by attenuating of which, they promote all the ſecretions. It is reaſonable therefore to ſuppoſe, that of ſcammony, elaterium, and the ſtrongeſt reſinous purges, not

more than one fourth gets into the blood; of jalap, ipecacuana, &c. one third; of rhubarb, ſenna, aloes, &c. one half; of cream of tartar, and the purging ſalts, two thirds. This being allowed, 1ſt, If the medicine acted only on the firſt paſſages, the doſe in perſons of the ſame ſize, would be directly as the conſtitution; for as the fibres of the reſt of the body, ſo are thoſe which compoſe the ſtomach and inteſtines. Where the conſtitution is the ſame, it will be eaſy to ſee that the doſe will be as the ſize; when both differ, the doſe will be as the ſize into the conſtitution. 2dly, Suppoſe the whole medicine to paſs into the blood; and the doſe will be as the ſize into the ſquare of the conſtitution: this is demonſtrated by Dr. Cockburn: and therefore, 3dly, You are to doſe ſo much of the medicine as is ſpent upon the ſtomach and inteſtines directly as the conſtitution; and ſo much as is carried into the blood, as the ſquare of the conſtitution, and the ſum into the perſon's ſize is the quantity required. There are ſome caſes exceptions to this rule, which ſhould be provided againſt: and, 1ſt, In conſtitutions which abound with acids in the firſt paſſages, we find the force of reſinous purges ſo weakned, that they ſcarce operate at all. They are alſo leſs active, or a larger doſe is required, when the body is full of aqueous humours; for the ſmall proportion of bile in ſuch conſtitutions not being ſufficient to cauſe a compleat ſolution of the reſin in the water, a conſiderable part paſſes off, without imparting any of it's ſubſtance; in perſons of a dry habit and in hot climates, they often cauſe intolerable gripings and hypercatharſes for want of due moiſture. But theſe and others of the like ſort, the cauſe being known, are eaſily remedied. And though not attending to, and being unacquainted with the ſtate of the body, in theſe particular caſes, may render this method leſs uſeful, it is no leſs true on that account.

Proposals for determining the effects of astringent; of attenuating; and of coagulating medicines; by the same. Vol. 5. art. 5.

IF the foregoing essay towards ascertaining the doses of vomiting and purging medicines is right, it may be extended to evacuants of all kinds. I shall now propose a more simple, as well as more certain way of determining the doses of some other medicines.

Dr. Hales (a) describes an experiment for determining the proportional force of astringent medicines. Having emptied all the vessels of an animal of blood, by letting it first bleed to death, and then pouring warm water through a long tube fixed into the descending aorta, while the intestines were slit open from one end to the other; he then poured different astringent liquors, observing the different times in which the same quantity of water and of the astringent liquors passed out at the cut vessels. He likewise informs me of a more easy method to try the different degrees of the restringency of medicines, viz. by moistening long animal fibres with them, when weights just sufficient to make them streight are hung to them. He thinks hairs of the head the most proper for this purpose, as being the most simple animal fibres, and which may be had nearly of the same strength. These he fixes to a lever made of a fine knitting needle, by which their minutest contraction is made sensible. By this method he found a slender untwisted fibre of hemp to lengthen on moistening, and not to shorten, as vegetable fibres are supposed to do.

(a) Hæmastatics.

The

The good effects of ſmall doſes of emetics and purgatives frequently repeated; *by Dr.* Alexander Thomson, *Phyſician at Montroſe.* Vol. 5. art. 6.

IN various diſorders of the ſtomach and lungs, where emetic and purgative medicines in full doſes have done no ſervice, great benefit has accrued from giving them frequently in ſmaller ones. The emetic I have uſed in this way is the emetic wine, and the purgative the tincture of hiera picra. A full doſe of either of theſe is to be divided into a number of ſmall doſes, which are to be taken, at proper intervals, in twenty-four hours.

The following caſes are inſtances of the good effects of this method. A girl about nine years of age, uſed toward night, and ſometimes in the morning, to throw up a viſcid, ropy phlegm; her fleſh became flabby, and her whole body weak and diſordered. She took ſometimes the emetic, and at other times the purgative, which cured her, and had the ſame good effects in ſeveral relapſes. She has now enjoyed perfect health a great many years. A poor man coughing mixt ulcerous matter, and emaciated to a great degree with hectic ſymptoms, had ſix drams of emetic wine mixed with two pounds of infuſion of extract of liquorice given him, which he drank daily. He had at times a tranſient nauſea, puked and expectorated plentifully. After he was accuſtomed ſome days to his medicine, the nauſea ceaſed, and the expectoration decreaſed. His daily doſe of emetic wine was increaſed to an ounce, intermitting a day ſometimes. The purulent expectoration gradually went off, and he recovered.

A lady of a bad habit of body and low ſpirits, was troubled with ropy variegated vomitings in the morning for a long time. After being treated with medicines in the common way to little purpoſe, ſhe took in

in twenty-four hours different ſmall doſes of the infuſion of hiera picra, which was gradually increaſed from one ſmall ſpoonful a day to two ſpoonfuls, always refraining the uſe of it when ſhe found any ſtirrings in her belly till they ceaſed. Sometimes a little Daffy's elixir was mixed. By theſe means ſhe got well, and recovered of a relapſe the ſame way.

The good ſucceſs of oppoſite cauſtics, and of a ſtrong alterative mercurial medicine. By Dr. Edward Barry, *Phyſician at Cork, and F.R.S.* Vol. 4. art. 4.

A Gentleman forty-five years of age had a hard tumor of the ſize of a turkey's egg formed in the coats of the teſtes, which ſlightly adhered to the right teſticle, and extended to the epididymis. Various internal and external applications were made uſe of to no purpoſe. A puncture was made, and a ſmall diſcharge of blood and ichor followed. The tumor continued large and ſchirrhous, with the appearance of a cancerous ulcer. The following method removed this diſorder.

A cauſtic of lapis infernalis two inches long was firſt applied; after the ſeparation of the eſchar, the lapis infernalis and oil of vitriol were alternately uſed, by rubbing the part firſt with the lapis infernalis, and in leſs than a minute afterwards with a piece of fir ſtick dipt in the oil of vitriol, which inſtantly removed the pain occaſioned by the lapis infernalis. At each dreſſing this application of theſe oppoſite cauſtics was repeated, till as much was waſted as was ſufficient; the moiſture was abſorbed by an armed probe and a digeſtive applied. By theſe means the tumor was gradually waſted every day, without any pain continuing, or inflammation ſucceeding; a ſmall part was ſuffered to remain adhering to the teſticle. This was thought more prudent than to run the hazard of injuring the teſticle. This application anſwered lately

in another very obſtinate ſchirrhous tumor in the coats of the teſtes, and in many caſes ſeems to be preferable to common cauſtics, the one correcting by it's oppoſite quality the too active ſalts of the other, and by that means inſtantly removing pain, and by producing a ſal tertium, which has a mild opening quality, and prevents an inflammation and callous lips, the common conſequences of cauſtic applications.

About three months after, a tumor appeared in the other teſticle of this gentleman, about the ſize of a walnut, which was removed by giving him going to bed fifteen grains of pilulæ ex duobus, ten grains of turpeth mineral, and the ſame quantity of camphire. It was ſeldom omitted any night. In the beginning it vomited him ſometimes, and purged four or five times, but at laſt operated chiefly as an alterative, and in three weeks not only carried off this tumor, but entirely removed the ſmall ſwelling which was left on the other teſticle. This medicine I have known ſucceſsful in obſtinate venereal and ſcrophulous diſorders.

Pulvis Stypticus recommended, particularly in uterine hæmorrhages. By Dr. ALEXANDER THOMSON, *Phyſician at Montroſe.* Vol. 4. art. 7.

PUlvis Helvetii has been long in repute as an aſtringent, eſpecially in uterine hæmorrhages. It is inſerted in the Pharmacopœia of Edinburgh under the title of Pulvis Stipticus, though the proportion of the ingredients, as well as the manner of making it, is different from the following. In the diſpenſatory two parts of alum is made into a powder with one of the ſanguis draconis; whereas what I have uſed was equal parts of both, the alum being firſt melted in a crucible, and the ſanguis draconis added to it, and then powdered together; poſſibly the difference of their effects may be but little.

I never

I never found any medicine (and I have tried several) so much to be depended on in uterine hæmorrhages; whether to correct the too frequent return of the menses, or their too great abundance; to stop the flooding which women with child are subject to; or to moderate the flow of the lochia.

The quantity I give is more or less according to the exigencies of the patient. In violent bleeding I give half a dram every half hour, and seldom or never miss to stop it before three drams or half an ounce is taken.

The success of this medicine in these evacuations encouraged me to prescribe it in the fluor albus, in which it had surprising good effects.

Violent effects of a mercurial suffumigation. By Mr. James Hill, *Surgeon in Dumfries.* Vol. 4. art. 8.

A Tall gigantic woman, sixty-three years of age, complained of a hoarseness and sore throat, which she had laboured under some months. I suspected the disease from some scabby crusts on her arms and forehead to be venereal, and was informed that it was a lues of four years standing. Her pulse was weak and low, and intermitted every third or fourth stroke; excrescencies about the pudenda were so numerous, that she could neither sit nor walk without pain. A cephalalgia and nocturnal pains were so violent as to prevent her taking any sleep. By the continuance of the disease and the operation of rough medicines, she was reduced almost to a skeleton. Notwithstanding her disease appeared desperate, I was willing to try cinnabarine fumigations, the efficacy of which Dr. Turner recommends in the very worst circumstances. On Monday, the first of April 1734, at nine o'clock in the forenoon, I burnt half a dram of factitious cinnabar under her nose and mouth, which she bore well, sucking in the fumes with little cough.

I left

I left her wrapped up, ſweating and ſpitting. By twelve ſhe had ſpit half a pound, and coughed a little. The room ſmelled ſtrong of a riſing ſalivation. Her pulſe was quicker and fuller, but irregular and intermitting. At three the room ſmelled ſtrong as of a high ſalivation. She had three ſtools, was very ſick, and complained of exceſſive gripes. Her pulſe was quick, low, and intermitted. I gave her ten drops of laudanum in a cordial aſtringent julep, and put her into bed with her clothes on. At nine ſhe was in a profuſe ſweat. Her pulſe was quick, full, ſtrong, and intermitted only one ſtroke of twenty-one or twenty-two. At midnight the gripes returned, upon undreſſing herſelf to go to bed naked. She took ten drops of laudanum as before, had three ſtools before the laudanum had effect, but grew eaſy as ſoon as the ſweating returned. In this condition ſhe continued all Tueſday; the gripes, ſickneſs, and intermitting pulſe returned every ten or twelve hours, and a profuſe ſweat ſucceeded the opiate draught. On Wedneſday morning the opiate was omitted, and ſhe had twenty ſtools, with ſickneſs and gripes, and her pulſe intermitted, by which ſhe was much weakned. In the afternoon the opiate was given in a glaſs of warm claret. She ſweated, and the ſymptoms diſappeared. She continued all Thurſday in the ſame way as Tueſday. On Friday morning at ſeven ſhe took a purging potion, which did not operate at nine. At eleven ſhe took ſomething to promote the purge, which operated ſo ſeverely, that at ſix ſhe ſeemed almoſt like one about to expire, but was relieved by her anodyne, and lay eaſy all night in a ſweat. Her throat was almoſt well, and the other ſores were healed. Saturday morning ſhe had the gripes, ſickneſs and irregular pulſe; yet ſhe walked ſix miles, and rode one or two in wet cold weather. On Wedneſday ſhe was no worſe. The purging continued to the middle of May. Afterwards ſhe took Dr. Plummer's pills, and drank a decoction of the woods. Theſe ſweated her plentifully during the

the warm weather, and ſhe became free of all her complaints. When the cold ſeaſon came on, a purging ſucceeded the ſweating now and then, till it went quite off in February 1735, when her legs began to ſwell, of which ſhe was relieved by two purges. But the ſwelling returned again, and ſhe being neglected, daily increaſed. She waſted, and died towards the end of April.

Hiſtories of gangrenes cured by the Peruvian bark.

A gangrene ſtopt by the Cortex Peruvianus. By Mr. Samuel Goolden, *Surgeon at Bridgenorth in Shropſhire.* Vol. 3. art. 5.

JAnuary the 8th, 1733, Samuel Lewis, aged ſeventy-ſix, of a pale complexion, and choleric conſtitution, a luſty and ſeemingly healthy man, ſhewed me an inflammation of his left leg, partaking of an eryſipelas and œdema, which extended from an iſſue below his knee, down to his ankle, and all round his leg. Evacuations and external applications were made uſe of to mitigate the inflammation, but to no purpoſe; for it tended faſt to a gangrene; his leg from an intenſe red turned livid, black bliſters aroſe, &c. I would have ſcarified it, but was not permitted. On the thirteenth day the tumor ſunk, his leg grew black and dry; his pulſe was quick with frequent intermiſſions; his countenance wild; his tongue hard and parched. He would not permit the neceſſary inciſions. About noon he took half a dram of bark in an ounce and a half of black cherry water, ſweetened with half an ounce of ſyrup of ſaffron, and repeated the draught every four hours. On the fourteenth day in the morning I found his tongue moiſt, and his countenance not ſo wild; his leg impoſthumated from a little below the ſuperior tubercle of the tibia down

to

to the ſmall, above which was a ſmall aperture with a little matter ouſing from it. I entered my ſciſſars at the aperture, and laid open the whole cavity, and diſcharged between three and four ounces of a well digeſted pus, and after fomenting with a decoction of the warm plants in a ſtrong lixivium of wood aſhes, ſal ammoniac and camphorated ſpirit of wine, (which I had uſed from the time I ſuſpected it would mortify) I dreſſed the inciſion with equal parts of baſilicon ointment, and linimentum Arcæi, ſpread upon a doſſil dipt in hot oil of turpentine, with a cataplaſm of equal parts of oatmeal, flowers of centaury, and camomel with the fomentation; and oil of camomel over all. He found an agreeable warmth about his leg after the dreſſings were applied.

On the fifteenth he was chearful, and a large ſinus appeared betwixt the ſolæus and gaſtrocnemius internus, which was laid open; and diſcharged the ſame quantity of matter as yeſterday. There was a large ſlough in the former inciſion, which I cut off, and dreſſed as before.

16. He had been reſtleſs all night; his pulſe was irregular, his tongue rough and dry, with fluſhings in his cheeks. He had not taken his draughts through neglect. The diſcharge was large, a fungus riſing in the firſt inciſion, which I ſprinkled with red præcipitate, and dreſſed as before: I ordered him a clyſter, which brought away ſome hardened excrements. At night his heat and fluſhings were not ſo great, and his tongue was moiſter.

18. Being wearied of his draughts, I ordered thus,

℞ Cort. Peruv. opt. pulv. unc. ſem. confec. alkerm. unc. i. M. divid. in bol. viii. cap. unam quartâ quâque horâ, ſuperbibendo cochlear. iii. Julap. ſequent.

℞ Aq. lact. ceraſor. nigr. a. unc. iv. Rut. unc. ſem. epidem. unc. ii. Tinct. croc. in aq. Teriac. fact. unc. i. Confect. alkerm. unc. ii. Syrup. cariophyll. unc. ii. m.

I obſerved matter lodged in the gaſtrocnemius internus almoſt to the back of the leg; on opening it, the diſcharge was not as I expected.

21. Com-

21. Compreſſes and bandage were applied to unite the cavity.

22. A ſinus running towards the ſmall of his leg was opened.

23. He complained of a pain in his ſide, and had a reſtleſs night; the ulcers were dreſſed only with dry lint, and the cavity inclined to unite.

24. Every thing appeared in good order, but he was much dejected.

25. He ſhewed me a ſwelling in his groin, with great hardneſs and inflammation down his left thigh, extending to a large tumor, which was inſenſible, above his knee, which he found gradually to increaſe ſince the fifteenth. An emollient plaiſter was laid over it; the diſcharge from his leg was very ſmall.

30. To this day the fever increaſed with an irregular pulſe, notwithſtanding he continued the bark as before. Very little diſcharged from his leg, the ulcer appearing livid was fomented, and the digeſtive applied warm as before. The ſwelling in his groin very much increaſed, but the inflammation abated. Matter was felt to fluctuate, but deep. The tumor was not very painful: not having a ſtool for ſeveral days paſt, he took a purge which gave him a large ſtool of black fœtid excrements.

31. The tumor above his knee appeared of a livid colour, that in his groin riſing towards a point near the inguen.

February 1, and 2, inſtead of matter there was a diſcharge of clotted blood from his leg.

3. The pus was laudable, the tumor in his groin conſiderably raiſed. He took a purge, which gave him one ſtool.

11. The fever continued, but not in any great degree, with the irregular pulſe. A white puſtule appeared on the moſt prominent part of the tumor in the inguen, which being opened, full three pound of matter, ſometimes ſtreaked with blood, guſhed out in a full ſtream. His leg began to cicatrize.

12. A great difcharge from the laft incifion. Some matter fell below the orifice. A cauftic was applied to it's loweft part, and difcharged about half a pound. The tumor near his knee was opened, and one ounce of well digefted pus was taken from it.

19. Another finus on the infide of his leg was opened, from which came feveral clots of blood. The difcharge from his thigh gradually leffened, the finus united, and the fever left him. He had taken between ten and twelve ounces of the cortex by the fourteenth inftant, when he left it off. By the ufe of bitters he recovered his appetite, and on the twenty-fifth of March he walked near a quarter of a mile. In the day his leg fwells confiderably, but in the morning is of it's natural fize; for which I ordered a laced ftocking. His thigh is ftrong and firmly cicatrized, as alfo is his leg, and the man enjoys good health.

A mortification cured by the Peruvian bark. By Mr. John Paisley, *Surgeon in Glafgow.* Vol. 3. art. 6.

FEbruary the 9th, a furgeon of a fcorbutic habit of body, about forty years of age, had the top of a pimple on the middle of the under lip cut off by accident, which upon going abroad fwelled, turned hard, with an inflammation all round it: the fwelling increafed, and notwithftanding he had been blooded twice, and the frequent ufe of a fomentation for four or five days, extended itfelf to the angles of his mouth, and fome way along the cheeks all round the chin, with great pain, and with vaft diforder through his whole body.

On the fifteenth at eleven at night a fmall black fpot appeared, not where the wound was, but on the middle of the red part of the lip, which fpread fo faft, that by eleven next forenoon it covered near one half of his lip, which ftood out very much. The fomenta-

mentation was continued with a decoction of the woods. But the mortification ſtill ſpread, and in three hours covered almoſt his whole lip, reaching inwards and downwards to the gums, the neighbouring parts ſwelling and growing hard. Upon this, he took half a dram of bark betwixt three and four o'clock in the afternoon. At 10 at night the mortification did not appear to be increaſing. He then took another doſe. Towards the morning of the 17th his lip was fomented, and he took a third doſe. At ten of the forenoon his lip was dreſſed, and the mortification had ſpread no further. At night ſomething like a ſuppuration appeared at the place where the pimple was, but none at all on the mortified part. That night he took another doſe of the cortex, and continued to take one in the morning, and another in the evening for two weeks.

The fomentation and ſpirits being applied twice a day, and a little emulſion given him for drink, without any other medicine than the cortex, the ſuppuration ſucceeded well in the mortified parts, on the third day after he began to take that medicine; upon which, proper digeſtives and other dreſſings were applied. The ſloughs caſt off very well, the hardneſs and ſwelling went away, and in 12 or 15 days the lip healed up, though with a conſiderable contraction by the great loſs of ſubſtance.

A gangrene cured by the bark. By Dr. George Thomson, *Phyſician in Glaſgow.*

A Gentleman of ſeventy-ſix years of age, who had been ſcarce ever ſick till he was ſeized with an hemiplegia two or three years ago, of which he recovered ſo well, that he walked abroad by the help of a ſtaff, April 10, 1735. complained of a pain in the toe, next to the little one in the right foot; but neglecting it two or three days, till the pain increaſing with an ouzing of ichor from a ſmall black ſpot, and

his ancles ſwelling, ſome tincture of myrrh and aloes was applied to it.

On the 14th, the ſwelling had gone a good way up his leg, and the ſpot was black and dry. Antiſeptick fomentations and the tincture were uſed. Notwithſtanding which, and a mixture of juice of hemlock and ſpirit of ſalt armoniac, with the tincture, all the ſymptoms increaſed. Next day a draught of the bitter decoction, in which half a dram of the bark had been boiled, was preſcribed to be taken every morning. 17th, The bone of the toe appeared bare, the fleſh round it mortified, and black ſpots were ſeen on the ancle and calf of the leg. 18th, The toe was cut off at the ſecond joint, a digeſtive applied, and the leg embrocated with ſpirit of roſemary flowers, ſalt armoniac, and camphire. All the medicines being continued, there was no great change for three days. 21ſt, The black ſpots looked paler, but the toes were all livid. 22d, His pulſe intermitted, and he was very uneaſy. 23d, The toes were black. 24th, The ſore grew fœtid. The black ſpots in the leg began to diſappear. 25th, The ſpots were of a pale red colour. A great pain in the ſole. No great change on the 26th and 27th. 28th, The little toe was cut off. Appearance of ſuppuration, with violent pain in the ſole. 29th, The patient was very feveriſh, raved with wild looks, and had no ſleep. An emollient poultice applied to the ſole. 30th, Still raved. Swelling of the leg almoſt entirely gone. No ſpots on it. May 1ſt, bloody ſanious matter let out by an inciſion in the ſole, where the tendons were bared. 2d and 3d, as formerly. 4th, The two remaining leſſer toes having mortified were alſo taken off. The great toe a little livid. 5th, The upper part and ſole of his foot ill coloured. His appetite now firſt failed him. 6th and 7th, Little change. 8th, Fifteen grains more cortex added to each draught. 9th, The ſwelling in the leg much diminiſhed. 10th, The ulcers in the foot larger. 11th, As on the preceding day. 12th, Towards night he had frequent faintings, an intermitting pulſe, great oppreſ-

ſion, and ſickneſs with ſtruggling. Took ſp. lavendulæ compt. and ſalin. aromat. 13th, Much relieved, but ſtill confuſed with wild looks. 14th, He was calm and chearful, with a regular pulſe. 15th, The ſwelling of the leg being gone, the embrocation was laid aſide. 16th, The ulcer was cleaner. Half a dram more bark was added to each draught. From this to the 26th of June his cure went on ſucceſsfully, with his dreſſings and decoction. June 26th, The foot began to ſwell with great pain. 27th, The ſwelling increaſed up the leg; and the great toe, which had been hitherto of a bluiſh, came nearer to a black colour. The decoction was continued, and the embrocation again uſed. The ſwelling, with black ſpots about the ancle, increaſed up to his knee before the 7th of July, when the ulcer in his foot was black. Inſtead of the bitter decoction he was ordered half a dram of the bark morning and evening. July 8th, Black ſpots appeared above as well as below the knee; one of them was two inches in diameter. 9th, The ſwelling of his foot leſs. 10th, His right teſticle ſwelled. Little change till the 15th, only the ſwelling of the teſticle abated. 15th, He would ſit up. The leg ſwelled greatly. 16th, Many ſmall, livid, or pale red ſpots above the knee. Till the 20th, the appearances all better; the ſwelling diminiſhing; the ſpots going off; the ulcer digeſting. 20th, He had little ſleep, and great pain; his pulſe was oppreſſed, and he very faintiſh: he took ſome cordial drops without any relief. The doſe of his bark was increaſed to two ſcruples morning and evening. Next day the leg looked worſe, but better the two following. 24th, In the night before he had a great ſweat of the thigh and leg, and the ſwelling was fallen two inches. The cure went well on with the cortex till Auguſt 10th, when a ſmall tumor was obſerved near the heel; the matter from which diſcharging at the ulcer in the ſole of the foot, it was afterwards cured by compreſſion. The ſwelling of the leg appearing to be only œdematous was bandaged up

to the knee. In the beginning of October, when the ſores ſeemed to be near cured, he omitted the bark, but a bliſter as big as a hen's egg, riſing on the great toe of the left foot; and two days after, ſuch another appearing on the great toe of the right foot, he returned to the uſe of the bark. The ſkin which they covered, is freſh and clean. The other ulcers are now near healed, and we reſolve to continue the bark ſome time after the cure, to prevent relapſes. During all the time of the cure, except when the patient was ſick and oppreſt, he would not be confined to any regimen in diet, but indulged himſelf even in a plentiful uſe of ſalt meats and ſtrong malt liquors.

Caſe by Mr. William Wood, *Surgeon in Edinburgh.*

A Young woman, who was brought very low by what was judged an atrophy, from obſtructions in the meſentery, had her feet greatly ſwelled in the œdematous way, as all the depending parts of her body, even in a lying poſture, were. The ſkin on the ſuperior part of the right foot having become black, with all the other ſymptoms of mortification, the mortified foot was fomented with an antiſeptic decoction, the gangrene ſcarified, baſilicon with oil of turpentine applied in the inciſion, and a cataplaſm of theriaca put over all. She immediately began to take a ſcruple of the bark four times a day. Three days after, the mortified parts began to ſeparate from the ſound: in two days more ſhe neglected her doſes of the bark; ſoon after there was no more appearance of any further ſeparation; which on taking the medicine went on as formerly. Her former diſeaſe killed her in few weeks, without any further progreſs, or new attack of the gangrene.

Caſe

Caſe by Dr. Thomas Simson, *Profeſſor of Medicine in the Univerſity of St. Andrew's.*

JOhn Daw, about fifty years of age, after being employed all day in ſupplying corn to a mill in a ſieve, felt an uneaſineſs near the inſertion of the tendon of the flexor of the laſt joint of the fore-finger, where the edge of the ſieve reſted; the joint was alſo a little ſwelled. He applied ſome white lilly-root to it. Eight days after, the whole finger and part of the metacarp were ſwelled, and a ſerous dark coloured matter iſſued from a ſmall opening at the ſecond and third joints of the finger. I directed him to apply a warm poultice of oatmeal, to let blood, to take a mercurial bolus at night, and ſome jalap next day. After the purge, which operated mildly, he grew feveriſh, and his hand much worſe, the two under joints of the finger being quite mortified. There was a large gangrenous bliſter both on the back and fore-part of the metacarp next to the finger. A conſiderable florid eryſipelatous ſwelling, which pitted when preſſed, ran up to his elbow. The gangrened parts were fomented with ſpirit of turpentine, and he took half a dram of bark every fourth hour. Next morning the inflammation had made no further progreſs, and in the evening the ſwelling and redneſs extended no higher than his wriſt, and below it the appearances were better, the parts being more ſenſible, and a ſuppuration beginning round the middle joint of the fore-finger. He continued the bark, and on the 15th day from the beginning of the diſorder, the mortified parts entirely ſeparated, the bliſtered ſkin caſt off, and a brown liquor iſſued from an ulcer, which penetrated from one ſide to the other of the articulations of the firſt bone of the fore-finger with the metacarp. The two mortified joints were cut off. The uſe of the bark was continued eight days longer, but in fewer doſes. The ſtump was gradually cover-

ed with flesh, and after a tendon was cast out of the ulcer in the metacarp, all the sores speedily cicatrized.

Case of Mr. Morton, *an Apothecary in Coventry.*

MR. Morton laboured more than a year under a sore throat, occasioned by a spot at the root of his tongue, no bigger than a six-pence, which was looked upon as cancerous, and which various methods of cure had no effect on. At length he made trial of the bark, and after using it some time, he spit up a great deal of dead filth from the sore, which filled up, though it was still painful, and hard about the edges.

Case by Mr. Gibson, *Surgeon in Edinburgh.*

MR. Alexander Bayne, aged forty, of a gross scorbutic habit, on the 4th of June 1735. was thrown from a horse on the pin of a cart, by which a large penetrating wound was made in the under part of the umbilic region, towards the right side, through which the omentum fell down four or five inches, with its lower edge lacerated. There was also a simple fracture of the fibula of his left leg. The colour of the omentum being changed from it's exposure to the air, a ligature was made upon the sound part in the usual manner, and the cawl cut off within half an inch of the tying. The external wound was dressed with a warm digestive, supported with compresses and bandage, so as to prevent the prolapsus of any of the other viscera. The fracture of the fibula was easily reduced and dressed in the ordinary way. He was plentifully blooded and an emollient clyster was injected. The two following days, no extraordinary symptom appearing, he was dressed as formerly. On the seventh of *June* the digestion was begun, on the eighth there was a reasonable discharge of well-digested pus. But on the ninth he had passed a restless

reftlefs night; his tongue was white but not parched, and the degree of fever not confiderable; the dreffings were dry, and fomewhat more than two inches round the wound the parts were livid and infenfible. Scarifications and a fomentation were immediately ufed, warm oil of turpentine applied, and a poultice of theriaca moiftened with fpirit of wine was laid over all, and half a dram of bark was given every fourth hour, with a fmall glafs of old ftrong claret. In the evening, the mortification had made no progrefs, and a kind of dew appeared on the dreffings, which were renewed. The bark was regularly given through the night, which he paffed with more eafe than the preceding. Next day there was a difcharge from the wound of excellent matter. The bark was continued till the fourteenth, when not only the wound but the incifions yielded laudable pus. On the fifteenth, the fracture was dreffed and appeared in a good way. On the fixteenth he complained of a fenfe of cold in the foot of the fractured leg; the fkin was livid and cold as ice, with gangrenous veficles here and there, which were cut and fomented. The wound in the belly difcharged only a fmall quantity of a fœtid bloody ichor; the colour of the fkin round it being much paler than ufual. Wherefore the bark was again taken, which anfwered fo well, that at the next dreffing, well concocted matter had run from the wound, and the natural heat and colour of the foot was reftored. The ufe of the bark was continued for a confiderable time, the neceffity and excellency of which was apparent; for if in the firft three weeks, the diftance of time between taking each dofe exceeded eight hours, the matter was in lefs quantity and of a much worfe quality. The cure was finifhed in five weeks.

Cafe

Case by Mr. JAMES CALDER, *jun. Surgeon in Glasgow.*

A Boy of twelve years of age, of a good constitution, by jumping violently, strained the articulation of the foot, and a tight bandage being applied to it, the inflammation was greatly increased, and black spots appeared upon the skin. His pulse was high and quick. The common methods with a variety of medicines were used for eight days to no purpose. At length a scruple of the bark was given four times a day. Six days after, the putrid parts separated and cast off, and the cure went on as that of a mild ulcer uses to do.

Case by Mr. MONRO, *Professor of Anatomy.*

ROBERT Biggins, a middle-aged labouring man, by a fall broke both the bones of the leg three inches above the articulation of the foot. There was a large wound on the anterior part of the fracture; a violent inflammation and tension of the whole leg, with a mortification near the wound. For the first four days he was treated in the common method for gangrenes; the tension yielded a little, but the gangrene advanced. On the fifth day he took the bulk of a nutmeg of an electuary composed of bark and syrup of cloves three times, the usual applications being continued. On the sixth there was a remarkable change for the better. On the 7th, the fomentation used hitherto, being neglected, the pain became violent, and the appearances worse. The bark and fomentation being again used, the bad symptoms decreased daily. On the twelfth the fracture was reduced, and the cure went afterwards on in the common way.

Case

Case by Mr. John Douglas, *Surgeon in Edinburgh.*

——Porteous, a labouring man about twenty years of age, having fractured his arm by a fall had it bandaged up, without reducing the fracture. Thirteen days after, a large swelling and a considerable mortification were brought on the part. His pulse being felt at the wrist of that arm in a natural state, and there being little tumor in the hand, the gangrened part was scarified, and the patient took half a dram of the powder of the bark every three or four hours. Ten days after the swelling of the arm was fallen, and a great share of the sphacelated parts were separated. On a nice inspection, all the parts under the fractured bones were mortified. The limb was amputated close by the head of the os humeri, beyond which the mortification extended a considerable way; so that the surgeon had great difficulty in stitching the artery, and was obliged to apply bandages, and therefore could not scarify, nor use the common medicines in such cases, but was obliged to trust entirely to the bark, which was given as formerly. In a few days, a good suppuration came on, and the patient cured easily and is now in good health.

The effect of Peruvian bark in gangrenes, ulcers, and the small pox, by Alexander Monro, *Professor of Anatomy in the University of Edinburgh, and F. R. S.* Vol. 5. art. 10.

A Young gentleman very healthy in appearance, had strained his left hand, but had no uneasiness in it for ten or twelve days, when he was suddenly seized with a sharp pain near the os pisiforme of the wrist, and soon after the integuments of the anterior part of the metacarpal bone of the little finger swelled.

led. Two days after, a mortification begun; the ſkin was ſcarified, the part fomented, and ſome digeſtive ointment with oil of turpentine applied; which dreſſings were continued the third day.

On the fourth day, the teguments covering the ſhort muſcles of the little finger were all mortified; his pulſe was ſo low as ſcarce to be felt, the ſtroaks ſo quick as hardly to be numbered. He had a tremor all over his body, with a frequent ſubſultus tendinum, a conſtant anxiety, reſtleſneſs and delirium; his tongue was parched and dry, and whatever food or drink he took was thrown up almoſt as ſoon as down. The gangrened parts were again ſcarified and fomented, their edges dreſſed with warm baſilicon, and a ſmall proportion of oil of turpentine; and a poultice of theriaca was put over all. Soon after his bowels were emptied by a clyſter, and as ſoon as its operation was done, five ounces of warm milk, and a dram of the bark in powder were injected, which he retained. This injection was four hours after repeated, and twice more in the night.

Next morning he had no raving, tremor, ſubſultus or vomiting, and his pulſe was ſtronger and ſlower. The hand was dreſſed as before, and the injection repeated; in the afternoon it was changed at the patient's deſire, for a bolus of half a dram of the bark, which was repeated every four or five hours. The fever ceaſed; the gangrened parts began to ſeparate next day; and the bark being continued for ſeveral days, the cure went on.

In all the gangrenes where the bark was given with ſucceſs, it brought on a mild ſuppuration, which became worſe when the uſe of the bark was interrupted, and again turned of a good kind when it was repeated. This led me to give it in ſeveral ſores where the ſuppuration was faulty, in which it generally did good ſervice, and the bark became a common and beneficial medicine in this town for ſuch ſores.

This effect of the bark led me to give it to ſeveral variolous patients, where either a right ſuppuration did

did not come into the puſtules, or petechiæ ſhewed a diſpoſition to a gangrene; and I had the pleaſure to ſee the effects I expected from it. The empty veſicles filled with matter; watery ſanies changed into white thick pus; the petechiæ became gradually of a pale colour, and at laſt diſappeared; and the blackening of the pox began ſooner than was expected.

I gave at firſt the decoction, then the extract of the bark; and afterwards the fine powder mixed with ſome mild rich ſyrup, and an aromatic diſtilled water; in this form from ten to forty grains were ordered to be ſwallowed every four or five hours.

But there was ſometimes a neceſſity, eſpecially in childrens caſes, to uſe the bark in the form of clyſters; previous to which the bowels were unloaded by a clyſter, and then from half a dram to two drams of the Jeſuit's powder was injected, with a ſmall quantity of warm milk, to which ſome diaſcordium, or ſyrup of poppies was added, if the bark was retained too ſhort a time. Theſe injections were repeated morning and evening, or oftener.

I have hitherto only given the bark in the ſmall-pox, after the eruption, and continued it till the blackening was compleated; but am perſuaded, from the effects I ſaw of it in mitigating the ſecondary fever, that if it is given during the eruptive fever, it might be of uſe in determining the ſmall-pox to be of a favourable kind.

The bark however in ſome caſes may prove injurious; thus in the ſmall-pox, when the lungs are violently infarcted, I have ſeen patients almoſt ſuffocated after a ſmall doſe of it. In ſhort I pretend to recommend it no farther than as an excellent aſſiſtant to nature, in what the ancients call the concoction and maturation of the morbid humors, the effects of which appear in moderating the fever and bringing on a kindly mild ſuppuration.

Powder of tin, an anthelmintic medicine. By Dr. CHARLES ALSTON, *Professor of Botany and the Materia Medica in the University of Edinburgh.* Vol. 5. art. 7.

THE powder of tin has been uſed for many years as a remedy againſt worms, and particularly the flat kinds, which oftentimes elude the force of all other medicines; but few are acquainted with the proper doſe and manner of adminiſtering it, upon which it's ſucceſs chiefly depends. The effects of the following medicine have been ſo remarkable, that I think proper to publiſh it, and recommend it as a moſt valuable remedy for this loathſome diſeaſe.

A Receipt for the Fluck-worm.

Take an ounce and an half of pewther metal, and grind it ſmall to powder; take half a mutchkin of treacle, and take your powder and mix both together. The Friday before the change of the moon take one half of it, and the day thereafter take the half of the other half, and the Sunday thereafter the reſt of it; on the Monday purge.

To full grown perſons I give two ounces of the powder of pure tin, put through the fineſt hair ſieve, mixed with eight ounces of treacle, having firſt purged the patient the preceding Thurſday with an infuſion of ſena and manna. On Saturday morning I give half an ounce of the tin in two ounces of treacle, and as much on Sunday morning. On Monday they are purged again with the ſame infuſion. Though probably there is nothing in the day, yet I thought it not amiſs at firſt to follow in this the directions in the receipt, and finding the medicine ſucceeded beyond expectation, I never altered it.

I gave it to a woman for the tape-worm, who having been long troubled with this diſeaſe, had taken

en many medicines for it, and among the reſt ſmall quantities of this powder. She had often paſſed ſmall fragments of the worm, and was far gone in a hectic conſumption. This powder ſeemed to bring away all that remained of this tænia, for ſhe was never more troubled with it; the conſumption however continuing, at laſt carried her off.

I have often preſcribed it for the gourd worm, and it never failed to compleat the cure. A man who had laboured under this diſtemper for many years, and had taken a great variety of medicines to no purpoſe, took the powder as above, and was cured in five days. The firſt purge brought away a few worms, but none appeared the three days he took the powder, nor with the firſt ſtool after the ſecond purge; but in the ſecond he voided a large number. A month after the medicines were repeated, but not ſo much as one worm was to be ſeen in his ſtools, nor did he ever obſerve any afterwards.

This powder immediately cures the pain in the ſtomach occaſioned by worms, though it brings them not away till ſome days after.

Obſervations on the effects of lignum guaiacum in cancers. By Mr. John Love, *Surgeon in Greenock.* Vol. 5. art. 9.

THE virtues of lignum guaiacum in venereal diſorders, particularly ulcers, have been much commended, but its good effects in cancerous ſores are not ſo well known. Iſabel Chambers, about thirty years of age, of a bad habit of body, upon the healing up of ſeveral running ſores, had a large, hard, indolent tumor formed in her left breaſt, which in eight months increaſed to a great bulk, broke, and became a plain ulcerated cancer, for which I amputated the whole breaſt. Several days after, ſhe ſweated plentifully, and the ſuppuration went on well. The ſweating then ceaſed, and ſome days after, the lower

lower part of the wound looked in a gangrenous way, which appearance was removed by ſcarifications, fomentations, &c. and the uſe of the bark, but the matter of the ſore continued ichorous, and a knot of a white colour roſe a little below. On opening which, inſtead of pus, I found a ſubſtance reſembling cheeſe. This ſore put on an appearance between a gangrene and cancer, with a ſwelling between it and the larger wound, which was now about the breadth of a crown piece. I tried the method above with ſeveral other medicines without effect; the ſore became more painful, worſe coloured, and an inflammation and hardneſs were brought on the ſurrounding teguments. I then made her drink every day four pounds of a ſtrong decoction of guaiacum, made with four ounces of the raſpings boiled in ſix pounds of water till it came to the quantity preſcribed, and gave her ſome theriaca at night to make her ſweat; but this not ſucceeding, ſhe was purged with twenty-five grains of pil. cahiæ, and five of mercurius dulcis, the decoction of guaiacum being ſtill continued. After this the ſweats returned plentifully. Inſtead of the former applications the following was applied.

℞. raſur. lig. guaiac. unc. viii. herb. aromat. m. vi. m. coq. ex aq. font. q. s. ad colatur. lib. iv. p. fotu.

℞. colatur. hujuſce unc. vi. acet. vin. alb. unc. ii. farin. ſem. lin. unc. ii. fænugræc. unc. i. aven. ſ. q. coq. ad conſiſtent. cataplaſm. and I put a pledgit ſpread with liniment. Arcæi part. viii. ol. Terebinth. part. 1. on the ſore. By the uſe of this liniment, poultice and fomentation, a ſkin was brought on the parts in a little time.

A woman, about the time of her menſes leaving her, had ſeveral hard, painful, itchy tumors in the orifice of the vagina of the ſize of peaſe; ſeveral of them ſuppurated, and left a hard ſtool behind them; at laſt one increaſed to the bulk of a ſmall walnut; it was livid and very hard, painful, and itched intolerably. By ſcratching ſhe broke the ſurface of it, which diſcharged a bloody-coloured ſerum. By the uſe of the decoction, fomentation and cataplaſm, mentioned

in

in the foregoing caſe, except that I added a little ſal ammoniac to the poultice, ſhe was cured.

Vitrum antimonii ceratum, a ſpecific medicine in the dyſentery. By JOHN PRINGLE, *M. D. Fellow of the College of Phyſicians, and Profeſſor of Ethics in the Univerſity of Edinburgh.* Vol. 5. art. 15.

THE vitrum antimonii ceratum has for ſome time been held as a ſpecific in dyſenteries, but the preparation and manner of giving it have been kept a ſecret, till Dr. Young generouſly made it public. I have tried it often myſelf in ordinary caſes, and once in a dyſentery of four years ſtanding with ſurprizing ſucceſs.

The following receipt of the medicine and obſervations were communicated by Dr. YOUNG.

Take glaſs of antimony in powder one ounce, bees wax one dram; melt the wax in an iron ladle, then add the powder; ſet them on a ſlow fire without flame, for the ſpace of half an hour, continually ſtirring them with a ſpatula; then take it from the fire; pour it upon a piece of clean white paper, powder it, and keep it for uſe. This quantity loſt a dram of it's weight in preparation. The glaſs melts in the wax with a very ſlow fire.

After it has been about twenty minutes on the fire, it begins to change the colour, and in ten more, comes near the colour of ſnuff; which is a mark of it's being ſufficiently prepared.

The ordinary doſe for an adult is ten or twelve grains; but, for the greater ſafety, I commonly begin with ſix grains; to a ſtrong man I have given a ſcruple, which ſometimes works ſo mildly, that I have thought it too weak. To weakly conſtitutions I give five or ſix grains, increaſing the doſe afterwards,

 according

according to the operation. To a boy of ten years of age I give three or four grains. To a child of three or four years, two or three.

I gave it in dyſenteries with or without a fever, whether epidemic or not: and I have found it ſucceſsful where bleeding and vomits have been premiſed, and where they have not.

I never chuſe to give opiates in the beginning, eſpecially where there is great ſickneſs; becauſe, although opium gives relief to ſome, yet at other times I have thought both the ſickneſs and purging increaſed the following day. I never began with a larger doſe than ten grains, becauſe it frequently operates as violently at firſt, as twenty grains at laſt, even upon the ſame patient. In it's operation it ſometimes makes the patient ſick and vomits; it purges almoſt every perſon; but I have known it cure without any evacuation or ſickneſs; nay in violent dyſenteries they purge ſeldomer with it than without it. If it purge ſufficiently, or fatigue the patient, I intermit a day or two betwixt each doſe, as I do with other purgatives. As I have cured ſome with one doſe, I have been obliged to give others five or ſix, eſpecially when the firſt doſes have been too mild; and I have often thought weak doſes did no good in chronic caſes. After the ſecond or third doſe, the ſtools are ſeldom bloody, the gripes and ſickneſs abate much, and the mucous ſtools grow leſs viſcid. Give it with an empty ſtomach, for then I think it operates moſt mildly. Forbid drinking any thing after it, for three hours, unleſs the patient is very ſick or diſpoſed to vomit; in which caſe give warm water as in other vomits. Beware of giving it for a diarrhœa in the end of a conſumption. I have cured ſome other diarrhœas of long ſtanding with large doſes of it; but it has failed oftener here than in dyſenteries. I forbid the uſe of all fermented liquors, and recommend a milk diet with rice or bread, chicken-broth or water-gruel. I give nothing cold, unleſs it be a tea ſpoonful of gelly of hartſhorn, as often as the patients

 pleaſe;

pleaſe; and ſometimes I indulge them with the gelly of currans to refreſh their tongue. It may be given ſafely to women with child; and to children on the breaſt you may give half a grain.

The hiſtory of the two following caſes was wrote by Dr. Francis Pringle.

A gentleman's ſervant thirty years of age was taken ill of a dyſentery about the middle of January 1735. The uſual methods of cure gave him ſome relief, but the diſtemper returned with greater violence. On the 25th of January he was blooded for a violent ſtitch in his ſide. On the 26th he took the vitrum antimonii ceratum, which purged him briſkly, but eaſily enough, all day. His ſtools were ſerous, at night he took ten grains of pil. Matthæi, was eaſy next day, and had only two ſtools, but the pain in his ſide returning, he was blooded again. 28th, The antidyſenteric medicine was repeated, it puked him more than the firſt, and purged him immenſely from morning to night. His ſtools were ſerous without blood or gripes. At night the paregoric pills were renewed, he ſlept well. 29th, He was very eaſy, and altogether coſtive. 30th, He went abroad, and the air being a little colder, had ſome griping pains, with a tendency to purging; but having taken the paregoric pills at night was well next day. Some days after, he had a return of the diſeaſe, and twelve grains of the antimonial medicine were given him, by which he recovered, and had no relapſe.

Mr. ——— was ſeized with a looſeneſs, November 29, 1735, attended with a ſlight fever, thirſt, ſickneſs at ſtomach, pains in his belly, eſpecially below the navel. His ſtools were frequent, and for the moſt part bloody. Notwithſtanding the common methods of cure were made uſe of, the diſeaſe continued violent, though for the moſt part after the beginning without blood. December 11th, he took ſeven grains of the vitrum antimonii ceratum, which purged him that day twenty-three times, but without gripes, blood or ſtraining. At night he took twelve

grains of pil. Matthæi, which checked the purging a few hours. Next day he had twenty ſerous ſtools without gripes. At night he took fourteen grains of pil. Matthæi, and next morning eight grains of the medicine, which purged him as before, only the ſtools were grown more conſiſtent. At night fifteen grains of the opiate were taken. December 14th, the purging, which had been ſtopt as before, returned, and he had twenty ſtools. At night the pills were repeated, and he had ſome reſt, and was free in ſome meaſure of the purging. About ſeven in the morning he took ten grains of the medicine, which purged him plentifully as formerly. At night he took eight grains of the pacific pills, purged eighteen times next day, but eaſily; had eight grains of the pills again at night, and next day, December 17, took twelve grains of the antidyſenteric medicine, which gave him thirteen ſtools, ſeveral of which were conſiſtent like natural ones, and he was pretty well and hearty. At night he took eight grains of the opiate, and had no ſtool till eight in the morning; the thirſt and fever were leſs, he was eaſy, ſtronger, had an appetite, and purged ſometimes that day, but his ſtools were more natural. At bed-time he took eight grains of the pill, and had a good night. 19th, He took twelve grains of his medicine, which purged him about ten times very eaſily: he ſlept very well that night, though the paregoric was omitted. 20th, He had ſeveral ſtools, took the pacific pills at bed-time, had a good night, and purged but twice. 21ſt, Omitted the pills, and ſlept well. 22d, He took a ſixth doſe of the antidyſenteric medicine, conſiſting of gr. xv. which agreed well with him; from that time he continued in a way of recovery, ſeldom purging above twice a day. 31ſt, He was ſo well that he ſeemed to have got free of his indiſpoſition, and continued ſo without any relapſe.

An account of two trials made with Dr. YOUNG'S *antidysenteric Powder. By Mr.* ANDREW BROWN, *Surgeon in Dalkeith.*

WIlliam Loudon, about forty years old, was ſo reduced by the dyſentery, that he could ſcarce walk or ſit upright. After he had gone through the common methods of cure to no purpoſe, he took three doſes of the vitrum antimonii ceratum, of nine grains each, one every other day, which with a proper regimen carried off the dyſentery.

A man of eighteen years of age, laboured under the dyſentery for three months, with gripes and loſs of appetite; after bleeding he took three doſes of the above powder, ſix grains in a doſe, which ſuppreſſed the dyſentery, but did not entirely remove it; therefore he took three doſes more of nine grains each, which effectually carried it off.

Several caſes by Dr. THOMAS SIMSON, *Profeſſor of Medicine in the Univerſity of St. Andrew's.*

WIlliam Jervy, upwards of twenty years of age, was ſeized with a ſevere dyſentery. He ſcarce had any interruption in his purging attended with great anguiſh and ſickneſs, whereby he was greatly reduced. I gave him immediately fourteen grains of the ſtibium, which made him eaſier for 24 hours. Next day he got a clyſter of whey and camomel flowers, but grew worſe. The third I gave the ſtibium without ſucceſs, but this I aſcribed to cold in going to ſtool. Two days after I perſuaded him to a third doſe. He was ſo ſenſible of the good effects of it that he took a fourth doſe, which relieved him moſt of all. I directed a fifth to prevent a relapſe.

——— Murray had for ten days continued under a dyſentery, with horror, gripes, ſickneſs, &c. ten

grains given every other day for three times recovered her.

A young lady took for a vomit mercurii præcipitati Wurtzii gr. vii. at eight in the morning, which by eleven had vomited her five times, but ſhe continued ſick for twelve hours, and then began again to vomit and purge. In this caſe ſhe continued till nine next morning, when a doſe of liquid laudanum was given her, which made her eaſier that day; but the next her purging returned with blood and gripes. I gave her ſix grains of antidyſenteric powder. It was ſix hours before ſhe had a ſtool which was free from blood and of it's natural form.

A boy about fourteen had been ſubject to a dyſentery for a whole year. I gave him ſix grains for a doſe. His firſt ſtools were bloody, but the laſt untinged; the ſecond day he kept eaſy; the third his ſtools were again bloody. The fourth he got a ſecond doſe, but did not purge, and was free of gripes. Next day his ſtools appeared to form, though interſperſed with blood, which after this diſappeared. I gave him two other doſes to prevent a relapſe.

An old man about ſeventy was cured of a ſevere attack with two doſes of ſix grains each.

——— Taylor in the fifth month of her pregnancy was violently attacked with a dyſentery and teneſmus. The third doſe carried off the dyſentery, and the teneſmus yielded to clyſters of milk and camomel flowers.

——— Tod got the diſeaſe by fatigue and cold, and was quite cured by three doſes.

William Wilſon was cured by three doſes of ſix grains each.

February 1ſt, 1737, the dyſentery proved epidemic. I cured a great number with this medicine, and none required above a third doſe.

I gave it to a woman the tenth day after childbed with ſucceſs.

One woman who was brought very low by the diſeaſe took the medicine, drank under it large quantities

tities of cold water, and died. Her huſband at the ſame time recovered by it's uſe.

In uterine hæmorrhages it has been equally ſucceſſful. —— Simſon after a miſcarriage of three months continued flooding eaſily for four weeks. On the fifth it became ſo violent, that ſhe fainted perpetually and ſeemed ready to expire. Upon taking ſix grains, the flux abated in half an hour, and in leſs than four days ſhe was quite free of her diſeaſe.

I gave it to an old woman in an uterine hæmorrhage, which had ſome time been familiar to her, with equal ſucceſs.

—— Turpey miſcarried without paſſing off all the after-burden. Blood continued to ooze from her for three months. At length it increaſed to a plain eruption of a pound at a time, with faintings and great uneaſineſs. Six grains of the powder gave her more diſturbance than I had found it to do in any other caſe. A large quantity of the placenta came away loaded with grape-like hydatides.

A man aged ſeventy had been troubled with gripes for eight months, with now and then a looſe belly. He at length paſſed two or three gills of blood a day. After continuing five days in this way I gave him ſix grains; the firſt doſe leſſened the flux, the ſecond quite cured him.

Account of the effects of the vitrum antimonii ceratum. By Mr. JOHN PAISLEY, *Surgeon in Glaſgow.*

WHEN I at firſt uſed this medicine, I procured it from Edinburgh, by means of Mr. Stephen, Surgeon to General Whetham's regiment, who can vouch for it's effects in a great many caſes, where he and I attended. At firſt we gave only ſeven grains in a doſe, which was increaſed by degrees to fourteen grains to ſuch as we judged ſtrong enough to bear it, making it up in a bolus with conſerv. roſar.

 diaſcord.

diaſcord. or theriac. Edinenſ. allowing for drink water-gruel, with or without milk; at other times emulſions, tea or weak broth, and always an opiate after the operation. It ſometimes vomited, always purged without griping, or but very gently. When it vomited, it made the patient ſick before the operation; but that went off as ſoon as the medicine work'd downwards. When the parcel from Edinburgh was uſed, I made ſome by the directions given in the Edinburgh Courant, making uſe of white wax to beſmear the ladle, and not bruiſing the ſtibium. After keeping it on the fire the time ordered, I could not rub off any wax. When it was cold I rubbed it fine in a marble mortar. Of this I gave only three grains, and never above five, and found it work'd as well as what I had from Edinburgh. I gave it to above forty patients, who all recovered except three, where I could not blame the medicine. As the diſeaſe was epidemic, and attended with a fever at the beginning, I took away ſome blood before uſing it, giving it every other day, and in the intermediate days a light cordial, and if there was great pain in the lower belly, or rectum, an emollient clyſter. Four or five doſes when taken in time generally perfected the cure, but where the diſeaſe was of long ſtanding I have uſed twelve or fifteen doſes, and never once ſaw any bad effect from it. I have tried it in diarrhœas, dyſenteries, and colic pains from viſcidities in the inteſtines, and found it a ſafe eaſy purgative, ſometimes a gentle emetic, and a ſurer and ſpeedier cure than the ordinary methods which I uſed with many patients at the ſame time.

A further account of the effects of the vitrum antimonii ceratum. By Mr. James Stephen, *Surgeon to General Whetham's regiment.*

A Labourer in a ſugar-houſe (theſe people are very ſubject to dyſenteries) had been confined to his room

room ſix weeks, and ten days to his bed; his pulſe was low and frequent, his ſtools bloody, with a conſtant griping and teneſmus. Two grains of the medicine gave him one puke, and five or ſix ſtools; an opiate was taken at night. Next morning the ſymptoms were abated. The medicine was repeated every other day, adding a grain to each doſe till it was augmented to nine grains, with an opiate always the evening he took the medicine. This cured him, and he has continued well ever ſince.

I have had one hundred and ninety patients in dyſenteries, who were all treated in the ſame method, of which I loſt but one who turned hectic and died about the thirty-ſixth day after his being taken ill.

N. B. I never gave it where there was a ſtrong fever, hectic diſpoſition, or ſigns of a diarrhœa colliquativa.

A further account by Mr. JOHN GORDON, *Surgeon at Glaſgow.*

IN the harveſt 1736, many people were carried off with a diarrhœa and dyſentery. At this time I tried the ſtibium ceratum, and never miſſed of ſucceſs in ſome hundreds, except in one or two caſes where the patients were quite exhauſted before they took it. I prepared it as fine as calomel uſually is. Three grains is an ordinary doſe. I never exceeded five; one or two doſes frequently perfected the cure, and I ſeldom gave three. It was taken in the morning, and was often two hours before it operated. Some it only purged, others it purged and vomited, making them ſick for ſix or eight hours. A good doſe of opium was always given at night.

A boy of ten years of age, who had in vain tried the common methods for a diarrhœa, was cured with a ſingle grain of the powder, and a doſe of liquid laudanum, and continues well.

The

The effects of the succus radicis iridis paluſtris. By Mr. CHARLES RAMSAY, *Surgeon in Edinburgh.* Vol. 5. art. 8

ABout the middle of April 1736, John Murdoch, formerly an healthy man, complained of a general ſtiffneſs and an œdematous ſwelling on his face and breaſt, which was carried off by proper medicines. Towards the middle of Auguſt, he caught a ſevere cold at ſea, upon which the ſwelling returned and affected his whole body. He took a great many hydragogues and diuretics, &c. which mitigated the ſymptoms, but never effected any thing like a cure. By the twentieth of September, his body was ſwelled to ſo huge a ſize, as ſcarce to be known to be the ſame man. On the 25th, he grew feveriſh, delirious, aſthmatic, and was affected with epileptic fits, and was ſo monſtrouſly big and ſtiff as not to be able to move one joint of his body, excepting when he had a fit. Bliſters were applied to his head and back, inciſions made in his ſcrotum, legs and arms, from all which there was a plentiful evacuation. By this time the ſtrongeſt cathartics, ſuch as jalap, mercury, gamboge, &c. were quite ineffectual; whereupon eighty drops of the ſuccus radicis iridis paluſtris were given every hour or two in a little ſyrup of buckthorn, which made him paſs a great many quarts of water by ſtool that night. Next morning it began to loſe it's effects, and was gradually increaſed to the quantity of two drams every two or three hours, at laſt mixed with a fourth part of ſyrup of buckthorn, was given by ſpoonfuls, as he could bear the operation. In three days near fifteen gallons paſſed off from the bliſters, inciſions, and by ſtool. Several days after the juice was continued in ſmaller quantity, till by the evacuations he was reduced to a perfect ſkeleton. Afterwards he was laced in flannel, ſmoked with amber and maſtich, took ſtrengthening medicines, picked up and

and continued pretty eaſy, till the end of November, when he relapſed, turned feveriſh, and died apoplectic.

Remarks on the external uſe of tobacco and groundſel, and on the effects of oil of turpentine given internally. By Mr. John Stedman, *Surgeon at Kinroſs.* Vol. 2. art. 5.

TObacco beat into a maſh with vinegar or brandy, and laid on the ſtomach, has ſometimes good effect in removing hard tumors of the hypochondria. I know of two cures made by it. One is of an old man, who by ſleeping in the open air in the Weſt-Indies, while the night dews fall, was taken with a numbneſs of his whole body, which ſoon was followed by a purging and a vomiting, and theſe going off he had all the ſymptoms of the jaundice, with a hardneſs and pain under the ſhort ribs of his left ſide. The pain went off but the tumor increaſed. After variety of medicines had been uſed for five years to no purpoſe, a poultice of ſix ounces of tobacco was applied upon the epigaſtrium and hypochondria. In five hours after he vomited a deal of purulent matter, when the poultice was taken away the vomiting ceaſed. This poultice was continued every day for a month, by which means he was perfectly cured. The other cure is of a boy fourteen years old, who got rid of a hard indolent tumor in the left hypochondria, by an ounce of tobacco applied in the ſame manner.

Freſh erigerum, or groundſel, beat into a very coarſe pulp and applied cold to the pit of the ſtomach, hath had very good ſucceſs in curing of agues. It is to be uſed only on the days free from the paroxyſm, and cauſeth ſtrong vomiting ſome hours after it is applied.
Æthereal oil of turpentine in too large a doſe hath had very bad conſequences. A woman drank two drams of the oil in warm ale, which ſoon brought on a ſtrangury,

gury, bloody urine, and it's total ſuppreſſion, with a fever, violent thirſt, and vomiting; ſo that I deſpaired of her; but ſhe was happily cured by a warm bath, and drinking plentifully of Dr. Fuller's emulſio Arabica.

An account of the effects of the Coneſſi bark. By ——— Vol. 3. art. 4.

THIS tree grows on the Cormandel coaſt in the Eaſt Indies, where it is called Coneſſi, and is not unlike the Cadogapala of the Hortus Malabaricus. The Coneſſi-ſeca, or Coneſſi bark of the ſmall young branches of the tree, which has leaſt moſs or ſcurf on it, is to be choſen, and all the ſcurf is to be ſcraped off. This bark made into an electuary with ſyrup of oranges, and taken to the quantity of half a dram or more four times a day for three or four days, increaſes the firſt day the number and quantity of the ſtools, but without increaſing the gripes; the ſecond day the colour of the ſtools is mended; and on the third or fourth day, their conſiſtence generally comes near to a natural ſtate when it ſucceeds at all.

In recent diarrhœæ ariſing from irregularities in diet without a fever, it ſeldom fails to cure, if a vomit of ipecacoanha is given immediately before it's uſe.

The ſame management ſucceeds in perſons of a lax habit of body, who are troubled with a diarrhœa in moiſt rainy weather, a remarkable itching in the ſkin being felt on the third or fourth day. To ſuch the electuary ought to be given morning and evening for ſome time after they are cured. Their drink ſhould be water wherein rice hath been boiled, and ſometimes emulſions of the cold ſeeds with ſal prunellæ are neceſſary.

If there is a fever with the looſeneſs, it muſt be removed by bleeding and cool emulſions or decoctum album with ſal prunellæ before the bark is given.

Sometimes when the cauſe of a diarrhœa, ſtop'd by this medicine, lies beyond the inteſtinal canal, the patient,

tient, in a few days after, complains of a pain in the right hypochonder, or in the right ſhoulder, or over the ſtomach towards the right ſide, cauſing often a dull ſenſe of pain, near or above the left clavicle, with a feveriſh pulſe. When theſe ſymptoms appear, blood muſt be taken away, which will be ſizy, with a tough yellowiſh cruſt on the top, when it has coagulated. The bleeding ſeldom removes the pain entirely; but after the fever is brought ſufficiently down by the loſs of blood, I have ſeldom miſſed to compleat the cure by giving calomel, for ſome days, in ſmall quantities, as an alterative.

I ought to obſerve, that the bark ſhould be freſh powdered, and the electuary new made every day or ſecond day, otherwiſe the bark loſes it's auſtere but grateful bitterneſs on the palate, and it's proper effects on the inteſtines.

A further inſtance of the medicinal efficacy of this bark is given by Mr. Monro, who declares that he cured an obſtinate dyſentery of three years ſtanding, which had yielded nothing to a great variety of other medicines by giving this bark in the form preſcribed above.

An alterative mercurial medicine by ANDREW PLUMMER, *M. D. Fellow of the College of Phyſicians, and Profeſſor of Medicine in the Univerſity of Edinburgh.* Vol. I. art. 6.

THE Chymiſts having obſerved, that ſome ſimple preparations of antimony and mercury had ſurprizing effects in the cure of obſtinate diſtempers, employed their art to change theſe Herculean medicines into various ſhapes; but many of their preparations being found too rough, they endeavoured to correct them; their utmoſt ſkill was employed in uniting antimony and mercury together, ſeparating their noxious or uſeleſs parts, and combining their active principles. To theſe labours are owing the butter and cinnabar of antimony, mercurius vitæ,

Bezoardicum minerale, ſolare, lunare, joviale, and ſeveral other preparations, on which the moſt exorbitant encomiums have been laviſhed. But their too officious care has rendered many of them unactive, while others remain incorrigible and unfit for uſe. The medicine here recommended is from experience of it's effects. The ingredients, ſulphur auratum antimonii and calomelas, are well known; only I muſt take notice that the following method of preparing the ſulphur antimonii, according to Angelus Sala, appears to be preferable to the common ones. Reduce antimony into a groſs powder: ſeparate the finer parts by a ſearce, and put the groſſer into a flat-bottomed glaſs: pour in aqua regia till it riſes a finger's breadth above the antimony. When there appears a ſulphureous matter on the ſurface, and the antimony is covered with a yellow cruſt, decant the menſtruum, keeping back the ſulphureous matter; edulcorate the remainder with water. Then pour on it oil of tartar per deliquium to the height of two fingers. Boil the whole gently in a ſand-bath. Pour off the tinctures and add more oil of tartar, proceeding as before. To theſe tinctures add diſtilled vinegar, till the effervеſcence ceaſes. Place the veſſel again on warm ſand, and a powder will precipitate, which is to be ſeparated by a filtre, and dried on paper. This precipitate Tachenius imagines is the ſame which Helmont hints at, where he ſays, the true ſulphur of antimony reſembles common ſulphur, only it's colour is more of a greeniſh caſt. From this ſulphur he ſublimes a cinnabar, an infuſion of which has ſurprizing effects. And this ſeems to be the ſame with his mercurius diaphoreticus. Tachenius affirms that he found this an admirable remedy in the tympany. A liniment of this he ſays, infallibly cures tertian agues; Sala likewiſe accounts it a powerful aperient, diſcutient and ſudorific.

The preference which I have given to the ſulphur of antimony prepared as above to the common ſulphur auratum, is not only founded upon the authorities of

of others, but built upon a juſt obſervation. In the common preparation much of the true ſulphur is conſumed by the deflagration, and the precipitated powder conſiſts of many of the groſs earthy parts of the ſalts in antimony. But I muſt own that I have not ſufficient experience of Helmont's ſulphur, for what I have hitherto uſed was prepared in the common way. At firſt I uſed three parts of ſulphur of antimony, and two of calomel; but afterwards I took equal parts, and varied the doſe occaſionally. I have always preferred calomel to mercurius dulcis, as leſs apt to ſtimulate the bowels, or raiſe a ſalivation. But it is not ſufficient to ſimply mix them; they muſt be well levigated together, by which the bright red colour of the ſulphur is changed into a duſky brown. The doſe, regimen to be obſerved, and effects of this medicine, may be eaſily gathered from the following hiſtories.

A lady, about thirty, of a ſlender make and fine ſkin, being troubled with a porrigo capitis, with hard and dry cruſts, eſpecially on the temples, took ſeveral purges mixed with calomel, and afterwards went through a courſe of antiſcorbutic medicines, with ſome topical applications. By the uſe of theſe for ſome weeks, the ſcurf began to ſeparate; but, upon leaving them off, the diſeaſe increaſed. The ſcabby cruſts in a few months ſpread themſelves all over the ſcalp down the forehead, to the eye-brows and noſe, and along the ſides of the face to the ears. Upon the head theſe cruſts adhered in large ſpots firmly to the ſkin, and when rubbed threw off branny ſcales, but never oozed out any matter. Upon the face the ſcurf was thin and white, and in the interſtices of the ſcales the ſkin appeared redder than uſual. The reſt of the ſkin was clear from ſcales, and there was no complaint but of the itching of the parts affected. In this caſe I directed a ſmall quantity of mercurius dulcis, which in a few days raiſed a ſalivation; ſmall doſes of the ſame repeated every ſecond or third day kept it up at near three pints a day for four weeks.

Upon

Upon the declenſion of the flux, her head was fomented with a decoction of the more fixed antiſcorbutic plants, in which ſome ſoap was diſſolved, and the unguentum antipſoricum cum mercurio (a) was rubbed on it. By the uſe of theſe and the fleſh-bruſh the ſcabs quickly fell off, the ſkin, after it had been ſhaved, appeared clean and ſound, and the hair began to grow as thick as before. Thus the diſeaſe diſappeared in the winter; but in the ſpring the ſcurf began to ſpread upon the temples over the head and towards the face. This quick return of her diſtemper after a ſalivation, determined me to make trial of the ſulphur auratum antimonii. I mixed therefore three parts of ſulphur auratum antimonii, and two parts of calomel, with extract of gentian, adding ſome drops of oil of cloves, and divided the maſs ſo that ſix pills ſhould contain fifteen grains of the powder. Three of theſe were to be taken in the morning, and three at night, with a draught of a weak decoction of guaiacum, which was likewiſe to be her common drink. The fomentation and ointment were renewed, only inſtead of ſoap half an ounce of pounded ſulphur, and three drams of ſalt of tartar were boiled in two pounds of the decoction. The pills gave her no uneaſineſs, and had no tendency to vomit or purge; and though ſhe was eaſily moved to a ſalivation, yet this medicine did not affect her mouth, only about ten days after ſhe began the uſe of the pills, going abroad in a ſharp froſty day ſhe got a ſlight ſwelling in her face, and a clear thin ſpitting. However, by keeping herſelf warm in bed, the ſwelling and ſpitting were gone by next morning, having ſweated more than uſual that night. For during the uſe of this medicine ſhe found a gentle moiſture on her ſkin towards the morning. In the mean time, the cruſts fell off her face, and in four weeks were entirely gone, and the lady has continued two years without any appearance of the diſeaſe.

(a) See the Pharm. Edinburgenſ.

A per-

A perſon aged twenty-four had a ſudden eruption of large red ſpots or pimples on his face, on taking cold. Evacuations with a long uſe of tincture of antimony were of little ſervice. The antiſcorbutic juices, gum pills with ſoap, medicated whey and goat whey, though long continued, ſucceeded no better; nor did a ſix weeks ſalivation avail. The patient at length took fifteen grains a day at twice of the powder mentioned in the preceding caſe, and drunk plentifully of whey. In two months (in which there were ſome interruptions) the face turned ſmooth, and the complexion clear, with the aſſiſtance only of a drying and detergent lotion towards the end.

This medicine has appeared of ſervice in preventing the venereal infection from ſpreading, and in carrying off the dregs of the diſtemper. A gentleman who had a gonorrhœa too quickly dried up, was attacked with worſe ſymptoms of the diſeaſe, without any ſuſpicion of a new infection. He had a large bubo on each groin and a chancre on the præpuce, which was inflamed and ſwelled. After general evacuations and topics, a ſalivation was raiſed by mercurius dulcis, which carried off the chancre. Suppuratives were applied to the buboes, and at laſt eſcharotics. But before the buboes were entirely extirpated, the parts were ſuffered to cicatrize ſooner than intended, for the conveniency of the patient's affairs. However, to prevent as much as poſſible any bad effects, I preſcribed as follows.

℞. ſulph. aurat. antimon. calomel. non pp. ā. drach. ii. Calomelas in craſſum pulverem redactum lævigetur ſuper marmor, per vices addendo ſulph. antim. portionem, & diuturno tritu fiat pulvis ſubtilior. Dein

℞. pulveris præcedentis unciæ ſemis. gummi guaiaci drachmas tres, reſinæ guaiaci drachmam unam, balſami Copaiva q. s. ut fiat maſſa pilularum ex cujus ſingulis drachmis formentur pilulæ xii.

Three of theſe pills were taken every morning, and as many at night; and inſtead of the decoction of the woods, the patient uſually drunk

T whey.

whey. In ſome weeks the remains of the buboes were quite gone.

A perſon who had a virulent gonorrhœa and a ſmall bubo on one ſide, after the uſe of a penetrating fomentation, took three or four doſes of mercurius dulcis, which were purged off with the pilulæ cochiæ. By the uſe of theſe and of coolers, balſamics and detergents, the matter decreaſed, and grew of a better colour and conſiſtence, but did not diſappear, nor was the bubo much diminiſhed. Therefore I ordered the pills uſed in the laſt caſe, which in twenty days compleated the cure. This patient kept cloſe at home, lived on a ſpare cooling diet, and during the uſe of the pills and decoction ſweated plentifully.

A gleet which had laſted five months after the cure of a gonorrhœa, was carried off in a fortnight by theſe pills in the ſame doſe as before, and the uſe of Briſtol water. This patient did not ſweat univerſally, but there was a more than ordinary moiſture about the inguina and pubes, which ſmelt ſomewhat ranker than before.

From theſe trials this medicine appears not only free from the rougher effects of many mercurial and antimonial preparations, but likewiſe effectual in removing obſtructions formed in the remoteſt canals of the body, and in carrying off the recrements of ſome obſtinate diſtempers by inſenſible perſpiration or ſweat, provided it be properly managed and aſſiſted (*a*).

(*a*) Remedio antedicto Plummeriano non unum ſed plura inſtitui experimenta, præcipue in malo iſchiadico contumaci, lue venerea, & in ulceribus antiquis pedem inferiorem ultra quinquaginta numero obſidentibus, & ichorem continuo ſtillantibus magno dolore & pedis intumeſcentia, quæ omnia hoc remedio mercuriali Plummeriano ſecundum methodum antedictam in Dei gloriam correxi, & in priſtinum ſanitatis ſtatum ægrotantem reſtitui. Acta Acad. Natur. curioſ. vol. 5. obſer. 136.

ANIMAL

ANIMAL OECONOMY.

Some thoughts concerning the production of animal heat, and the divarications of the vascular system, being an abstract from a Latin treatise of the heat of animals. In a letter to Dr. JOHN STEVENSON, *Physician in Edinburgh; from Dr.* GEORGE MARTIN, *Physician in St. Andrew's.* Vol. 3. art. 11.

THE heat whereof every animal while alive has a considerable share, is generally believed to be owing to the motion of the blood in the vascular system. This motion, however rapid in the larger vessels, in the smaller ones appears too slow and languid to produce any considerable degree of heat. Some have therefore had recourse to chemical principles, and suppose that there is an animal process going on in the blood, resembling the effervescencies which occasion heat in chemical experiments, and that animal heat is owing to the intestine motion of the particles of the flowing blood. But on viewing the circulating blood in the small pellucid vessels of animals, no such motion appears, nor any one except the progressive course of the blood pressing and rubbing on the sides of the vessels. And this I think is the cause of animal heat, and am confirmed herein from observing that in the various circumstances of the human body, the heat generally in some sort corresponds to the degree of motion of the blood. And I hope likewise I shall make it appear that the system is so contrived, and the various motions of the blood so adjusted, that, bating external influences or disturbances, the heat of the circulating fluid generated by attrition is every where nearly uniform, notwithstand-

ing the different celerities in different parts of the animal machine.

In order to the clearing and ſettling of this point, I ſhall premiſe a general ſuppoſition, That the intenſity of heat generated by attrition is, cæteris paribus, in proportion to the relative celerity wherewith the bodies rub againſt one another.

And therefore if a liquor be propelled through a canal, the quantity of attrition of the liquor upon the ſides of the canal generating heat is in a compound ratio of the celerity of the liquor, and of the circumference of a ſection of the canal.

When a liquor moves through a canal, it's particles frequently, though ſlowly, ſhift places. Whence the quantity of attrition around the circumference of a ſection, is equally diffuſed through the whole ſection, ſo as to render the heat in every point perfectly uniform: and therefore the intenſity of heat in ſuch a ſection is as the quantity of attrition applied to the area of the ſection; that is, as the velocity of the liquor and the diameter of the canal directly, and the ſquare of that diameter reciprocally; which comes out as the velocity of the liquor applied to the diameter of the canal.

And from this it follows, that if liquors be propelled with celerities proportional to the diameters of their containing canals, the heat of theſe liquors generated by attrition will be equal.

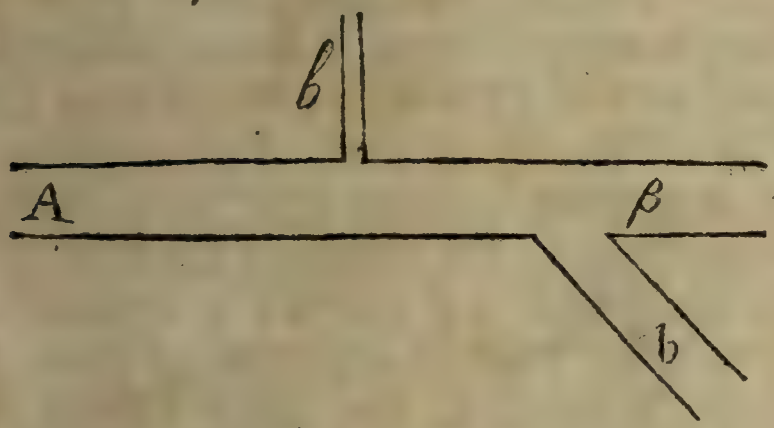
If a canal carrying the liquor be ramified into branches, the heat of the liquor generated by the lateral attrition may be conſtantly equal; or may be increaſed or diminiſhed in it's progreſs, through this ramified ſyſtem of veſſels, according to the method of it's divarication, or the proportion which the wideneſs of the branches bears to the wideneſs of the trunks from whence they ariſe.

For the heat of the propelled liquor generated by attrition is every where as it's celerity applied to the diameter of the canal, ſo that if the branches have always ſuch a ſituation and largeneſs with reſpect to the trunk,

trunk, that the velocities of the liquor moving through them ſhall always correſpond to their diameters, then the heat will be conſtantly equal. But if the branches be ſo adapted to the trunks, that the velocity of the liquor flowing in them ſhall be greater, equal, or even but nearly equal to that in the trunks, then the heat of the liquor would be conſtantly increaſing in it's progreſs through this ſuppoſed ramified ſyſtem, and that, cæteris paribus, in a reciprocal proportion of the diameters of the canals. And, on the other hand, if the capacities of all the branches put together ſhould be vaſtly greater than that of the trunk, ſo as to diminiſh the velocities of the liquor in a greater proportion of the diameters of the canals, then indeed the heat would be conſtantly on the decay.

The firſt of theſe caſes actually obtains in the animal machine; all the parts of it in a ſound ſtate are nearly of the ſame degree of heat, when left to themſelves, and defended from the air or cold, which I have confirmed by a thouſand experiments, and therefore it behoves us to enquire narrowly into the nature of ſuch a divarication, which may render the velocity of the blood always in proportion to the diameters of the containing canals, and conſequently give it a heat conſtantly equal.

Suppoſe any artery A to be divided into what number of branches *b*, *β*, b, you pleaſe, equal, or



however unequal, whoſe diameters we call *d*, *δ*, d, the diameter of the trunk A being D: ſo that their

 reſpec-

refpective orifices fhall be proportional to D^2, d^2, δ^2, d^2; while the celerities C, c, $\varkappa$, k, wherewith the blood is fuppofed to flow through thefe veffels, are required to be proportional to the forefaid diameters D, d, δ, d, refpectively.

Now in the divarications of any artery, the blood would flow into the feveral branches with nearly the fame celerity, if they all rofe with the fame obliquity to the trunk. Therefore it feems neceffary for the due balancing the velocity, to contrive the divarication in fuch a manner, that the larger branches fhall always lye in a directer courfe, and the fmaller ones in a more inclined one to the current in the trunk, that the quantities of the blood flowing into them may be in a greater ratio than they would otherwife receive; fo too that it may flow through them with the requifite velocities proportional to their diameters.

We come next to enquire what proportion the amplitude or orifice of the trunk muft have to the conjunct amplitudes of the branches, fo likewife as to preferve the abovementioned balance of celerity. In the firft place we are to obferve, that univerfally the quantities of liquor paffing equably in a given time through any canals, are in a compound ratio of the amplitudes of the canals, and of the velocities of the liquor conjunctly. Hence then the quantities of blood paffing in a given time through the branches b, β, b, are as $d^2 \times c$, $\delta^2 \times \varkappa$, $\mathrm{d}^2 \times k$ refpectively; to all which quantities the quantity furnifhed them by the trunk A, or paffing through the trunk in the fame time, muft be equal, and as $D^2 \times C$. That is then $D^2 \times C = d^2 \times c + \delta^2 \times \varkappa + \mathrm{d}^2 \times k$. And therefore, in the prefent cafe, (the celerities C, c, $\varkappa$, k, being fuppofed proportional to the diameters D, d, δ, d) $D^2 \times D$ fhall be equal to $d^2 \times d + \delta^2 \times \delta + \mathrm{d}^2 \times \mathrm{d}$; or $D^3 = d^3 + \delta^3 + \mathrm{d}^3$. That is, the cube of the diameter of the trunk, is equal to the cubes of the diameters of all it's branches added together; and fo D is $= \sqrt[3]{d^3 + \delta^3 + \mathrm{d}^3}$. That is, the diameter of the trunk is equal

equal to the cube root of the conjunct cubes of the diameters of all the branches.

From whence, if the proportion of the branches to one another be known, the ratio of them conjunctly to the trunk may be determined.

If a trunk divide itſelf into two equal branches, whoſe orifices are to one another as 1 to 1, and their diameters in like manner to $\sqrt[2]{1}$ and $\sqrt[2]{1}$, or 1 and 1; then by the general propoſition, the diameter of the trunk is proportional to $\sqrt[3]{1^3 + 1^3} = \sqrt[3]{2} = 1{,}2599$; and conſequently it's orifice muſt be $1{,}2599^2 = 1{,}5874$. So that the amplitude of the trunk is to the conjunct amplitudes of the branches as 1,5874 to $1 + 1 = 2$, or as 100 to 125,99.

Suppoſe a trunk divided into two, however unequal branches, which, for example, ſhould be to one another as 2 to 1; ſo that the diameter of the greater branch ſhall be proportional to $\sqrt[2]{2} = 1{,}4141$; that of the leſſer as $\sqrt[2]{1} = 1$. Then the diameter of the trunk is proportional to $\sqrt[3]{1{,}4141^3 + 1^3} = 1{,}45644$; and it's real largeneſs compared to the branches 2 and 1 ſhall be $1{,}5644^2 = 2{,}4473$. So that this amplitude of the trunk being to the joint amplitudes of the branches as 2,4473 to $2 + 1 = 3$, ſhall be to them likewiſe in the ratio of 100 to 122,586.

But ſhould the divarication be more complex, ſo that there be three and theſe very unequal branches, in the ratio perhaps of 3, 2, 1; whoſe diameters therefore muſt be proportional to $\sqrt[2]{3} = 1{,}73205$, $\sqrt[2]{2} = 1{,}4141$, and $\sqrt[2]{1} = 1$: Then the diameter of the trunk comes out proportional to $\sqrt[3]{1{,}73205^3 + 1{,}4141^3 + 1^3} = \sqrt[2]{9{,}02395} = 2{,}0819$, the ſquare whereof is 4,3344. Whence we find the trunk to be to the ſum of the branches put together as 4,3344 to $3 + 2 + 1 = 6$, that is as 100 to 138,42.

 I ob-

I obſerved before, that the heat in different parts of the body in a natural ſtate was every where nearly equal. And now having determined the laws of the divarication of a ramified ſyſtem of canals, wherein the heat generated by attrition ſhould be conſtantly uniform; let us in the next place enquire if theſe laws obtain in fact; and if anatomy and a true menſuration of the veſſels of the human body do in reality correſpond to our theory.

It is obvious at firſt ſight, that the poſition of the veſſels favours our ſcheme. The next thing we are to conſider is the proportion of the branches to their trunks. It is very difficult to ſurvey the veſſels of animals with a mathematical exactneſs. In meaſuring an artery, a line broad, who will undertake never to err $\frac{1}{200}$ of an inch? and yet an error ſo ſeemingly little will lead us into a miſtake near $\frac{1}{8}$ of the amplitude of the veſſel: ſo that the ſmalleſt unavoidable errors in meaſuring ſhall occaſion ſome ſeeming deviations from the rules which really nature may have followed. And therefore I hope even the moſt ſcrupulous will be ſatisfied, if upon examination it ſhall be found that experience and our theory are for the moſt part very little wide of one another. Phyſical experiments and practical mechanics allow only of an approximation to geometrical demonſtrations. It has been obſerved in general that the conjunct amplitude of the branches is always larger than of the trunks from which they ariſe; and conſequently that the blood on this account chiefly, ſuffers a vaſt retardation in it's progreſs from the heart to the extreme parts: But we do not ſtop in this general obſervation. From innumerable meaſures and experiments, we moreover pretend to find a determined proportion, and a very elegant harmony in the dilatation of the arterial ſyſtem, and in the retardation of the blood moving through it; to wit, that the diameter of every artery is equal to the cube-root of the conjunct cubes of the diameters of all its branches: And the velocity of the blood in the arteries always in proportion to their ſeveral

diame-

diameters; for the preservation of an equable degree of heat through all the system.

In the following collection of experiments, we have at one view the proportions of the trunks to the branches, both according to the theory and the measures which were taken of them, with the differences in these two circumstances. Which differences are less than we could well have expected, and which would have been but an half of what is here set down, if we had made our calculations of the diameters, and not of the amplitudes of the vessels. And they are the diameters which are primarily measured.

The Divaricated Arteries. From EUSTACHIO.	Tab.	Fig.	Proportions of the Branches. *		Conjunct Capacities of all the Branches. By the Theory.	By Measuring.	Differences.	
The right subclav. art. divided into the axillary and carotid.	16	16	11	12	126	129	$\frac{1}{42}$	+
A mesenteric artery.	11	1	8	5	124	122	$\frac{1}{62}$	—
A mesenter. art. in another subject.	27	4	1	1	126	119	$\frac{1}{18}$	—
The descending aorta split into the two iliacks.	12	1	1	1	126	128	$\frac{1}{63}$	+
	1	1	1	1	126	134	$\frac{1}{16}$	+
The same in another subject.	12	3	1	1	126	130	$\frac{1}{32}$	+
	1	2	1	1	126	123	$\frac{1}{42}$	—
The same in another.	12	4	1	1	126	120	$\frac{1}{21}$	—
	4	5	1	1	126	120	$\frac{1}{21}$	—
The same in another.	12	7	1	1	126	146	$\frac{1}{6}$	+
	1	3	1	1	126	132	$\frac{1}{21}$	+
The same in another.	12	9	1	1	126	138	$\frac{1}{11}$	+
	3	1	1	1	126	136	$\frac{1}{13}$	+
The same in another.	12	10	1 1	q. p.	126	136	$\frac{1}{13}$	+
	3	3	1 1	q. p.	126	123	$\frac{1}{41}$	—
The same in another.	12	12	1	1	126	114	$\frac{1}{11}$	—
	3	2	1	1	126	110	$\frac{1}{8}$	—
The same in another.	2	1	1	1	126	131	$\frac{1}{25}$	+
The same in another.	2	2	1	1	126	138	$\frac{1}{11}$	+
The same in another.	2	3	1	1	126	133	1/[illegible]	+
The same in another.	25		1	1	126	121	$\frac{1}{25}$	—
The same in a woman.	13		1	1	126	124	$\frac{1}{63}$	+

* The capacity of the trunks is all along set down in a column by itself, in the original, at 100.

From

The Divaricated Arteries.	Tab.	Fig.	Proportions of the Branches.	Conjunct Capacities of all the Branches. By the Theory.	Conjunct Capacities of all the Branches. By Meaſuring.	Differences.	
From Ruysch.							
The right ſubclavian branched into the axillary and carotid. Ep. Probl. 3.	3	2	2 1	123	136	1/10	+
The ſuperior branch of the ſplenic artery entering the ſpleen, Ep. Probl. 4.	4	2	4 4 1	136	125	1/12	—
Its inferior branch, ibid.			3 2	125	121	1/31	—
The uppermoſt art. from this inferior branch, ibid.			7 6	126	130	1/31	+
The lower one, ibid.			5 4	126	140	1/9	+
A meſenteric art. Muſ. Anat. p. 76.		5	1 1 q. p.	126	128	1/63	+
Its right branch, ibid.			10 9 q. p.	126	136	1/13	+
Its left branch, ibid.			5 1	113	108	1/23	—
From Keil.							
The ſuperior meſenter. art. ſpending itſelf in 21 branches, Tent. 4. p. 88.			2136, &c.	258	247	1/23	—
The 5th branch of the meſenteric. ib. p. 90. l. 15.			5 8	124	102	1/6	—
The larger branch of this 5th meſenteric. ib. l. 25.			5 9 8	142	150	1/8	+
The 3d twig of this larger branch, p. 91. l. 4.			4 3 q. p.	125	153	1/5	+
The 1ſt branch of the 8th meſenteric, ib. l. 12.			1 1	126	118	1/16	—
The 2d branch of the 8th meſent. ib. l. 16.			4 5	126	133	1/18	+
The 10th meſent. art. ib. l. 20.			6 5	126	117	1/14	—
The 1ſt branch of the 10th meſent. ibid. l. 24.			5 6	126	123	1/42	—
The 2d twig of this 1ſt branch, p. 92. l. 3.			1 1	126	105	1/6	—
The 14th meſenteric, ibid. l. 7.			1 1 1	146	144	1/73	—
The 15th meſenteric, ibid. l. 12.			4 5	126	127	1/126	+
The 2d branch of this 15th meſent. ibid. l. 16.			7 6 6	144	156	1/12	+
One of the twigs of this ſecond branch, ibid. l. 21.			3 4	125	137	1/100	+

The Divaricated Arteries.	Proportions of the Branches.	Conjunct Capacities of all the Branches. By the Theory.	Conjunct Capacities of all the Branches. By Measuring.	Differences.	
The femoral art. dividing into two branches, Tent. 2. p. 45. l. 2.	5 4 q. p.	126	157	$\frac{1}{4}$	+
Its second branch, ibid. l. 3.	3 5 q. p.	124	113	$\frac{1}{11}$	—
The 2d branch in l. 3. ibid. l. 4.	4 2 1	135	157	$\frac{1}{6}$	+
The 1st branch in l. 4. ibid. l. 5.	2 1	123	136	$\frac{1}{10}$	+
The 2d branch in l. 5. ibid. l. 6.	11 5	122	128	$\frac{1}{20}$	+
The first branch in l. 6. ibid. l. 7.	5 3 1 q. p.	135	114	$\frac{1}{6}$	—
The first branch in l. 7. ib. l. 8.	3 2	124	124	0	
The first branch in l. 1. ib. l. 9.	2 9	115	107	$\frac{1}{14}$	—
A branch of the femoral art. in its progress. ibid. l. 10.	3 2 30 q. p.	109	113	$\frac{1}{28}$	+
The 3d branch in l. 10. ib. l. 11.	1 5	113	112	$\frac{1}{113}$	+
The first branch in l. 13. ib. l. 14.	2 1	123	144	$\frac{1}{6}$	+
The first branch in l. 14. ib. l. 15.	5 6	126	120	$\frac{1}{21}$	—
The 2d branch in l. 9. ib. l. 16.	1 8 q. p.	109	187	$\frac{1}{5}$	—
The 2d branch in l. 16. ib. l. 17.	1 1 4	129	149	$\frac{1}{7}$	+
The 3d branch in l. 17. ib. l. 18.	3 2 30	109	109	0	
The 2d branch in l. 5. ib. l. 19.	10 9	126	122	$\frac{1}{31}$	—
From my own Dissections.					
The right subclav. branched into the axill. and carot. in a man.	3 2	125	111	$\frac{1}{9}$	—
The same in a woman.	4 3	125	124	$\frac{1}{125}$	—
The same in a young girl.	8 9	126	119	$\frac{1}{18}$	—
The right carotid, divided into the internal and external in a man.	3 2	125	127	$\frac{1}{63}$	+
The same in a girl.	7 6	126	107	$\frac{1}{7}$	—
The aorta ending in the iliacs in a boy.	1 1	126	06	$\frac{1}{6}$	—
The iliac artery branched into the internal and external in a man.	5 4	126	128	$\frac{1}{63}$	+
The same in a young man.	5 4	126	130	$\frac{1}{32}$	+
The same in a boy.	5 4	126	118	$\frac{1}{21}$	—
The same in another boy.	5 4	126	130	$\frac{1}{32}$	+
The same in another boy.	10 9	126	129	$\frac{1}{42}$	+
The same in a woman.	1 1	126	124	$\frac{1}{63}$	—
The same in a young girl.	5 4 q. p.	126	132	$\frac{1}{21}$	+
The same in another young girl.	5 4	126	131	$\frac{1}{25}$	+

From

The Divaricated Arteries. From Nichols.	Proportions of the Branches.	Conjunct Capacities of all the Branches. By the Theory.	Conjunct Capacities of all the Branches. By Measuring.	Differences.
An artery A (one of the mesent.) ramified into the branches B, C. Comp. Anat. Tab. 2. p. 2.	3 4	125	113	$\frac{1}{11}$ —
The branch C divided into D, E.	1 2	123	116	$\frac{1}{17}$ —
The branch E divided into the branch 36, and another Z which I find to be about 21.	5 3	124	116	$\frac{1}{15}$ —
The branch Z ramified into the twigs 16 and 9.	5 3 q. p.	124	119	$\frac{1}{25}$ —
Miscellaneous Observations.				
A branch A of the ext. carot. into the ant. and post. branches C, B. Du Verney's Org. de l'Ouie. Tab. 2. fig. 1.	5 3 q. p.	124	100	$\frac{1}{5}$ —
The same, ibid. fig. 2.	4 3 q. p.	125	130	$\frac{1}{10}$ —
The ant. branch after throwing off D, subdivided into two branches, ib. fig. 1.	2 1 q. p.	123	133	$\frac{1}{12}$ +
The aorta ending in the infer. mesent. lumb. and iliacs. Verh. Anat. Tab. 16. fig. 1.	3 1 1 40 40 q. p.	132	134	$\frac{1}{66}$ +
The aorta ending in the iliacs, the inf. mesent. 4 lumb. and 3 sacræ. Cowp. An. T. 3.	23 26 2 1 1 &c.	140	124	$\frac{1}{9}$ —
The right iliac into the ext. and int. ibid.	1 1	126	106	$\frac{1}{6}$ —
The left iliac divided in the same way, ibid.	1 1	126	105	$\frac{1}{6}$ —
The Cœliac into 2 branches. Cheseld. An. T. 17. 2.	3 2 q. p.	125	132	$\frac{1}{18}$ +
The larger branch of the Cœliac into lesser branches, ib.	9 9 5	142	144	$\frac{1}{71}$ +
The sup. mesent. into three br. ib. 3.	5 6 1	129	139	$\frac{1}{129}$ —
The inf. mesent. divided into three branches, ib. 4.	11 20 11	121	133	$\frac{1}{12}$ +
The desc. aorta ending in the iliacs, ib. T. 15.	1 1	126	121	$\frac{1}{25}$ —
The Cœliac Art. b. into the right and left, Stukely of the spleen, Tab. 1.	9 10	126	105	$\frac{1}{6}$ —

In

In this collection there are indeed but few obſervations which perfectly jump with the exact proportions of the theory; but many coming near them; and the numbers of thoſe coming ſhort of it, and thoſe which exceed it are nearly equal. And the common or middle exceſs or defect is only about $\frac{1}{14}$ part. Nay in about ninety obſervations, from the exceſſes and defects balancing one another, the ſizes of the branches determined by our rules, and thoſe found out by the moſt carefully made experiments, come out almoſt exactly the ſame. The odds being about $\frac{1}{600}$ or $\frac{1}{700}$ parts; a quantity in ſuch a caſe to be eſteemed as nothing.

Thus it appears both by the theory and practice, that the arteries of the human body are diſtributed and divaricated in ſuch a manner, both in their poſition and wideneſs, that the celerity of the blood flowing through them may be preſerved in a given proportion to their diameters; and the ſame, or nearly the ſame degree of heat generated by attrition, continued along the whole arterial ſyſtem.

To obviate ſome difficulties which might be ſtarted againſt us, we muſt obſerve, that for the eaſier reception of the blood, the artery is always a little wider in it's riſe from the trunk, from whence it converges in a conical form: And that arteries conſidered as trunks, juſt before they ſplit into branches, muſt be widened a little for the more convenient divarication; ſo that if an artery, from the beginning of it's riſe to it's ramification into branches, happen to be very ſhort, it will commonly be found wider, and have a greater proportion to its branches than our theory would require. In which caſes, though the blood has a ſlow courſe through the trunks, yet in ſuch ſhort intervals it loſes no heat. And on the other hand, for the like reaſons we need not be afraid of the heat being too much increaſed, though it ſhould move ſomething faſter in the end than in the beginning of the long converging arterial trunks.

An

An eſſay on the cauſe of animal heat, and of ſome of the effects of heat and cold on our bodies; by JOHN STEPHENSON, *M. D. fellow of the college of phyſicians at Edinburgh.* Vol. 5. art. 77.

THE knowledge of the animal œconomy is well worth the purſuit of phyſicians. Several parts remain ſtill in great obſcurity. A ſolution of the following problem may not only ſet ſome parts of the theory in a clearer light, but, what is of infinitely more conſequence, poſſibly improve the practice of medicine.

To what organs or operations is the heat of the human body owing?

I ſhall not examine the opinions of former ages which have been long exploded, but only ſuch as at preſent prevail.

The firſt is, that the heat of animal bodies is owing to the attrition betwixt the arteries and the blood.

The ſecond, that the lungs are the fountain of this heat.

The third, that the attrition of the parts of the ſolids on one another produce it: To which I add a

Fourth, which is more neglected, namely that whole proceſs, by which our aliment and juices are conſtantly undergoing ſome alteration.

1. The arguments in favour of the firſt opinion are: That if an artery is tied or cut, the part to which it goes turns cold. On the ceaſing of the pulſation of the arteries, cold and death follow. An increaſe of heat attends a briſk circulation, and a languid circulation is accompanied with a ſmall heat. One who burns in a fever, or is hot with exerciſe, has a full and frequent pulſe; in cold faintings, chloroſis, &c. the pulſe is ſmall and ſlow; and laſtly, that the thermometer ſhews the arterial blood to be a little hotter than that of the veins.

2. This is accounted for from the conical figure of the arteries; from their flexures and branchings into exquiſitely ſmall capillaries, whence the reſiſtance and conſequent attrition muſt be great; from the number, ſtrength and elaſticity of their coats; from the propelling power of the heart, and their ſtrong reſiſtance. From all theſe the particles of the blood perpetually getting new motions, directions and rotations, are attenuated, condenſed, have their angles grinded off, and are made homogeneous: Hence the fluidity, red colour, and heat of the maſs which is here perfected.

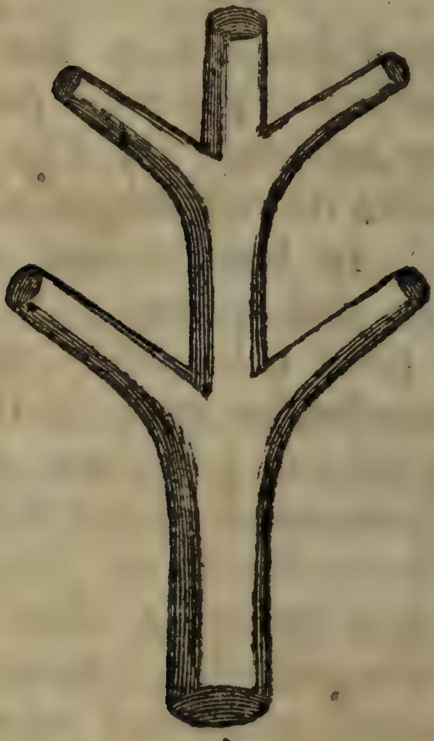
But this theory is doubtful. 1. For (a) what is ſaid of arteries may be ſaid of any other parts, whoſe functions are neceſſary to life. (b) The heat and pulſation of the arteries do not keep together in any regular proportion: In ſome morbid caſes, there is a great ſenſible heat, and a ſmall pulſe; and in others a full pulſe and great coldneſs †. Beſides (c) all the length this demonſtration goes, is to ſhew that the motion of the arteries and heat are generally in proportion, which however does not ſhew which is the cauſe, and which the effect, nor indeed that either is the cauſe or effect of the other, ſince both may be the effects of ſome other cauſe (d). As to the proof by the thermometer I doubt of it, and (e) what adds to my doubts is that the venal blood does not coagulate ſo ſoon as the arterial. In ſhort, this theory is not eſtabliſhed by any ſatisfactory and convincing proof.

In the ſecond place, let us examine the ways by which this hypotheſis is accounted for. And firſt (a) as to the conical ſhape of the arteries, I can by no means allow them to be cones, ſo as to infer the action of a converging canal on its contents. Look at portions

† Quam quidem refrigerationem haud ſemel iſti fere, qua rigent cadavera, parem comperi, pulſu nihilominus recte ſe habente. Sydenh. Oper. Univerſ. p. 391.

of

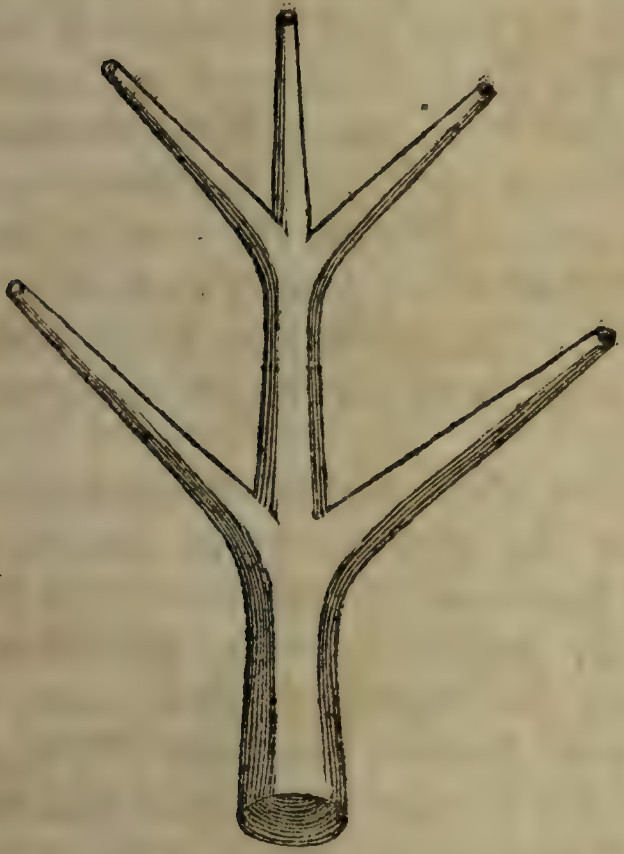
of arteries injected; examine the figures of the veſſels from Italy preſented to the Royal Society by Mr. Evelyne; look at the tables of Euſtachius, Veſalius, Caſſerius, &c. and you will find the portions of the artery betwixt the ramifications to be for the moſt part cylindrical, and to diverge as frequently as converge. No doubt as the branches draw off the blood, the trunk diminiſhing may in a groſs ſenſe be called conical, and that A is a much larger ſection than X.



But as the blood moves ſlower at X than at A, it is contrary to the laws of hydraulics, to apply the effects of hollow cones on liquors flowing in them from the baſe to the top, to the action of the arteries on the blood, ſince in the firſt the liquor muſt neceſſarily flow quicker at the top of the cone; and in the arteries we find the blood moves ſlower the further it is removed from the aorta, which is conſidered as the baſe of the cone. The arterial ſyſtem may with more propriety be ſaid to reſemble cylinders, frequently divided and ſubdivided, ſtill terminating in numbers of ſmaller cylinders, the aggregate of which is always of greater

greater capacity than the trunk or larger cylinder before the ramification. But if they will have the artery a cone, let it be inverted, and the blood flow from the top to the baſe as it really does: But then down falls all that reaſoning which was founded on the doctrine of the cone.

Bellini has ſome expreſſions (a), which with his ninth figure here inſerted, have made the writers after him



take theſe things for demonſtrated, which are neither true, nor, in my opinion, meant by him to be thought true. But the abſurdity of a liquor flowing in a

(a) Si canales ſint anguſtiſſimi ad orificium minus, quemadmodum ſunt canales minimi cujuſcunque animalis, &c.——ita liquidum fluens per ejuſmodi conicos canales exiliſſimos, nitendo in orificia anguſtiſſima, ſibi ipſi eſt fluendi vis & impedimentum. De motu bilis. Prop. 26.——Quoniam vero univerſa arteriarum ſeries conica eſt, & fluxus ſanguinis per ipſas eſt ab ampliori orificio verſus anguſtius. ibid. Prop. 28.

full conical canal from the baſe to the top, and yet more ſlower at the top than at the baſe, and Bellini's own expreſſion (quaſi conicus) makes me of opinion that he uſed the cone for facility of demonſtration, matters being much the ſame in a ſyſtem of infinitely divaricated canals, as to the obſtacles and reſiſtances the blood had to overcome in its way, from the heart to the veins, which were the main things he had to ſet forth.

Boerhaave, in treating of the fabric of the blood-veſſels, expreſsly calls the arteries cones and conoids, and applies the form and properties of hollow cones to them. Yet after all this pomp of mathematical ſcience, ſo capable of amuſing the ſcholars, the plain truth muſt come out. In a few words he deſtroys all the arguments built upon the cone (a), and fairly allows that the arteries gradually increaſe in number and capaciouſneſs, that the motion of the blood is ſwifteſt near the heart, and ſloweſt at the greateſt diſtance from it (b).

(β) As to the number, ſtrength and elaſticity of the coats of the arteries, which are ſaid to cauſe this heat, they ſeem unfit to produce it; the blood in them moves every moment ſlower, and there are ſeveral contrivances for making it flow, even almoſt ſtagnant, in order to ſome ſecretions. The greateſt conquaſſation of a homogeneous liquor raiſes no heat; and it is not reaſonable to expect it from the bare propelling force of the heart, through the arteries on the contained fluid.

γ The heat from attrition is chiefly laid on the infinite ramification of the ſmall arteries where almoſt

(a) Arteriæ quidem cernuntur eſſe canales ad ſenſum conoidei. §. 132. Ergo vitalis cruor fluit quidem per arterias, ſed fluxu eunte a corde ad extrema ex latiori in anguſtiorem partem. §. 142. Cruori pulſo in arteriam reſiſtit ſanguis arterioſa vaſa replens conica arteriæ figura. §. 215. Quia ergo omnis omnino ſanguis tanto vi agitur, & ingenti adeo obſtaculo repellitur in canali pleno conico, &c. §. 217.

(b) Quia vero arteriæ ſenſim augentur numero & capacitate —— erit itaque cæteris paribus, velociſſimus circa cor, tardiſſimus remote a corde, motus humorum circumeuntium. §. 222.

every globule of blood rubs the ſides of the capillaries: even here it is very unlikely that the blood ſhould acquire heat, eſpecially when we conſider the ſoftneſs and lubricity of its parts and of the canals and the exceeding ſlowneſs of its motion. If the motion, and conſequently the heat, decreaſes in the ſmaller veſſels, when every globule ſuffers an attrition, the matter is not mended in the larger arteries, where, though the blood by its greater velocity, ſtrikes more forcibly againſt the ſides of the veſſel, yet the portion of it that touches, is too ſmall to warm the whole ſection. The great ſeeming difficulties the blood has to overcome in the ſmall veſſels, which have given riſe to this opinion, would have diſappeared, if Bellini and his followers could have been ſatisfied with Borelli's illuſtration of the circulation in minimis, by a filter or wet ſpunge, through which water flows without any greater force than the weight of liquor in the depending part. And that this is the true theory, will be readily believ'd by thoſe who are of opinion, that the circulation begins and ends with the veins.

I ſhall conclude what I have to ſay about their accounting for this ſyſtem with Boerhaave, who aſſerts that the fluidity, heat and colour of the blood, depend upon the action of the arteries on it (a). There are ſtrong preſumptions, of which we have above alledged one, againſt the greater fluidity of the blood in the arteries: That it gets its colour here is not true, for the blood firſt appears florid in the pulmonary veins: And as it has its colour before it arrives at the left ventricle, ſo it has its heat before it comes to the right, at leaſt the blood's acquiring heat in the arteries more than elſewhere, has not hitherto been evinced either by argument or experiment.

The proper office of the arteries ſeems to be the diſtribution of the blood for the purpoſes of nutrition, ſecretion, excretion, and moſt of the conſiderable animal functions. As they have no immittent ducts, and as the blood is but a ſhort time in thoſe of the

(a) Ex his ſequitur totius maſſæ fluor, calor, color.

greateſt importance, the coronaries for inſtance, and as it can receive nothing but motion, and ſuch attrition as a motion, every moment growing ſlower can give, it is improbable that its colour, heat, and fluidity are owing to them, eſpecially as in the veins, it meets with new matter every now and then, from all the different parts of the body, and particularly with new chyle, and in the lungs with what we ſhall not at preſent give a name to.

I ſhall at preſent admit (tho' I do not think it true) that the circulation promotes the heat, in ſo far as it moves the heterogeneous maſs, and makes its inteſtine motion greater than it would be in a ſtagnant ſtate: But from this to infer that the action of the ſolids on the fluids, is the cauſe of animal heat, is as abſurd as to ſay, that the ſhaking of a bottle, containing an effervеſcent mixture, is the cauſe of the inteſtine motion; the heat is augmented by the ſhaking and the action of the inner ſurface of the glaſs on the contained fluid, but not cauſed by it. The foregoing reaſons ſeem to prove that the blood does not owe its heat to the arteries.

II. I ſhall now examine the ſecond opinion, which is, That the lungs are the fountain of heat in the human body. All that has been ſaid for the blood's being heated in the arteries, is advanced to prove this hypotheſis, with conſiderable addition, viz. That in the lungs, the blood veſſels every where attend, divide and ſubdivide along with, the ramifications of the wind-pipe; and as theſe are perpetually changing their ſituation and form, becoming longer or ſhorter, making more acute or more obtuſe angles; ſo muſt the concomitant blood-veſſels every moment make new angles, and give the blood new directions; that at laſt the blood enters into an exquiſite fine net-work, ſpread every where on the vaſtly thin air-veſicles, where theſe little air-bladders are perpetually changing their angles, points of contact, their form, volume, interſtices, and ſo forth: from theſe, and the elaſticity of the air, and weight of the atmoſphere, the blood

blood is ſaid to be churned, preſſed backward and forward, broken and kneaded together, diſſolved and condenſed, made red and hot in reſpiration.

This theory, however plauſible, is not ſatisfactory; for, 1. What was ſaid before of the improbability of heat being generated by the ſole attrition of ſolids or fluids, is ſtrong here.

2. Tho' the lungs be regularly ſupplied with plenty of air, which has weight and elaſticity enough to carry on the alternate ſwelling and ſubſiding of the veſicles; yet life and heat ſoon fail, if that air has, by paſſing through the fire, or any other way, been robbed of ſome particles or quality, different from its weight and elaſticity.

3. The argument from the additional action of the ſolids of the lungs on the blood, more than what is found in the arteries, from their greater and conſtantly varying motion, ſeems to be fully taken off, by one part of Hook's experiment, exhibited before the Royal Society; in which the lungs of a dog being kept conſtantly diſtended by a freſh blaſt of air, the dog lived, and his heart beat regularly; ſo that there is no need for that frequent and great variation of angles, and points of contact, upon which the additional attrition is built.

4. That the cold air ruſhing into the ſpongy lungs, on the numberleſs air-bladders, of which the blood is almoſt ſuperficially ſpread, ſhould make the blood hot, is an improbable opinion, and ſupported by no proof. And as the cauſe appears not at all promiſing a priori, ſo the effect ſeems to demonſtrate this not to be the cauſe. For

5. That the blood is rather cooled than heated in the lungs, may be inferred from the benefit received by the inſpiration of cool air in many inflammatory diſeaſes, eſpecially thoſe of the lungs. In burning fevers, with a full quick pulſe, red ſkin, and a large and quick reſpiration, I have given relief by opening a window, and admitting a ſtream of cool air to breath in: the effects of which I have carefully ob-

ſerved to be that (tho' the body continued cloſe covered) in one minute the reſpiration became ſlower; and very ſoon after the pulſe abated of its fulneſs; and not only the face, but the whole body, of it's fiery heat and colour.

6. If the blood were heated in the lungs, we ſhould need leſs of their function, when we are warm, or in a warm place; the heat of our bodies, or of the atmoſphere, doing ſo much of the office of the lungs; and that we ſhould want more of it, when cold, or cool air. But when we are hot, and want to be cooled, we breath full and quick; and when we are cold, and want to be warmed, our reſpiration is ſlow and ſmall; contrary to what one would expect, if the action of the air on the blood in the lungs, were to heat it.

7. The blood which comes from the ſmall veſſels of the lungs, is not more expanded than before, as has been aſſerted, but not proved by any experiment, which it would certainly be, if it was hotter: for moſt liquors rarify by heat, and few more than blood, as I hope to make evident, when I come to treat of the warm pediluvuim.

8. If the blood owes its heat to the action of the lungs, we muſt look out for another ſource of heat in the egg and fœtus. To the objection that the heat of the mother is ſufficient for the purpoſe, till this new function comes into action, I oppoſe two obſervations. The firſt is, that toward the end of incubation, I am told, an egg may be left by the dam, in a cold ſeaſon, for a little longer time than would be ſafe for the chick, if all its heat depended on her; yea long enough for an egg that contains no warm principle, to become of the temperature of the ambient air. Yet, upon opening it, the chick has been found, neither quite ſo cold nor dead. The ſecond is, that a ripe fœtus, taken away from the mother, but continuing within the membranes, can live ſeveral hours by its own heat, without any aſſiſtance from the lungs.

What

What is the cauſe of this heat before the lungs act? How comes to it fail as ſoon as the lungs play?

The III. opinion is, that the cauſe of animal heat is owing to the action of the ſolid parts upon one another. The heart and arteries move moſt, and it's natural to expect, that the heat ſhould be owing to this motion. But even this does not ſeem very plauſible, from theſe few conſiderations among many others.

1. The moving parts, however we term them ſolid, are neither hard nor dry; which two conditions are abſolutely requiſite, to make them fit to generate heat, by attrition.

2dly, None of their motions are ſwift enough to promiſe heat in this way.

3. They have no great change of ſurface in their attritions.

4. The moveable fibres have fat, mucilage or liquors every way ſurrounding them, to prevent their being deſtroyed, or heated by attrition.

IVth Cauſe of the heat of our bodies, is that proceſs, by which our aliment and fluids are perpetually undergoing ſome alteration. Before I enter on this ſubject, I ſhall premiſe a few points which are univerſally agreed to.

1. The inteſtine action of the minute parts of mixed bodies on one another, is capable of producing as great a heat as can be produced by the mutual attrition of the hardeſt bodies: From gunpowder will ariſe as great and ſudden heat, as from flint and ſteel (a).

2. The parts of mixed fluids acting on one another, are capable of raiſing great degrees of heat: there are cold liquors, which, when mixed, produce inſtantly a fierce flame. (b)

3. No attrition or action of any ſolid body, or any homogeneous fluid, has been ſhewn to create heat. Water, oil, and the like, have been conquaſſated long, with great violence, without being warmed.

(a) Surely theſe two degrees of heat are not equal.

(b) Philoſophical Tranſact. n. 213, p. 200.

Nor does the experiment of cream's becoming warmer by being churned, invalidate this: the heat there is owing to an effervefcence, happening on the alteration, by which the component parts of the milk, which is a heterogeneous fubftance, are changed and feparated in making butter.

4. No confiderable alteration of mixed fluids, has been made by the fole action of folids on them, independent of the action of their minute parts on one another. No churning of a vegetable juice, attenuates its oil into alcohol; no conquaffation of a lixivium, changes the falt of it from a fixed to a volatile nature.

5. It is agreeable to the laws of natural philofophy, to reafon on the chemiftry of the animal body, as well as on the mechanics of it; and the minute component parts of folids, have a fet of laws peculiar to them, and their intimate changes and actions on one another, are not to be accounted for by the coarfer mechanical laws.

6. Moft of the chymical proceffes, where the texture of the fubject is much changed, are attended with heat. Fermentation and putrefaction have fomething analogous to the animal procefs, and make great alterations in the fubject of it. An enquiry therefore into the known appearances of thefe two proceffes, may caft light on the animal one. In fermentation (firft) there is an inteftine motion or attrition of the parts of the fluid. (2) This motion is not owing to any mechanic action, or influence of the containing veffel. (3) Air is fome how neceffarily concerned, whether in being feparated from the fermenting mafs, or mixing with it; poffibly indeed both; for it is conftantly emitting air, and the procefs is foon quenched in vacuo, or when fhut in with a fmall portion of air. (4) It is always accompanied with a fenfible degree of heat. (5) The liquor becomes thinner, and grofs lees are precipitated.

Secondly, after it is completed, the moft remarkable changes of the fubject, are, That (1) The oil, or

or a conſiderable part of it is found ſo attenuated and volatilized, as to riſe firſt in diſtillation, and though ſeparated from the phlegm, to continue ſuſceptible of a mixture with water. (2) Still the ſalts which remain continue fixed, as before the proceſs. (3) The ſubject ſtill retains its vegetable aceſcent nature, and can be changed to vinegar or an acid ſubſtance.

In putrefaction (1) There is likewiſe a great inteſtine motion. (2) When carried to a height, and when the putrefying ſubſtance is much compreſſed, it is accompanied with great heat and ſmoke, and ſometimes flame. (3) Air is alſo neceſſary to it. (4) The viſible texture of the putrefying maſs is changed.

After the proceſs, the moſt notable changes of the ſubject are, That (1) in diſtillation, after a little phlegm, with a ſmall fire, there ariſes a volatile alkaline ſpirit and ſalt; and, (2) On calcination there remains no fixed ſalt.

In the animal proceſs we are conſidering, (1) The ſubject of it is moſtly the ſame with that of the other two, being at leaſt originally of vegetable ſubſtances. (2) Air is ſome way neceſſarily concerned in the proceſs; either in mixing with or ſeparating from it or both; our food has air mixed with it, our fluids yield air in the pump, and we cannot ſubſiſt either in the exhauſted receiver, or ſhut in with a ſmall portion of air. (3) It is generally accompanied in our bodies with a degree of heat, greater than in fermentation, and leſs than the higheſt putrefying heat. (4) By it the texture of the conſtituent parts is minutely changed.

(1) Our juices which have fully undergone this proceſs are ſo far out of the vegetable claſs, that they will not turn acid but rancid. (2) The ſalts, which by fermentation could not be raiſed out of the vegetable fixed ſtate, here loſe their fixed nature; for no lixivial ſalt remains in calcination: But they are not exalted to ſuch a degree as in the higheſt putrefaction, where, in diſtillation, after a little phlegm, there ariſes early and with a ſmall degree of fire, a volatile ſpirit and

and ſalt: Whereas our blood in diſtillation yields only phlegm with a ſmall fire, and no volatile ſpirit or ſalt for a conſiderable time, and not without great force of fire.

This proceſs may be one ſui generis, perhaps ſomewhat of a middle nature betwixt fermentation and putrefaction; ſeeming by the product to come ſo near the latter, that I incline rather to call it by that name: For there is ſuch a proceſs, we have the ſame materials, we have a fit place for it, a conſiderable degree of preſſure by the contracting force of our veſſels, the air not quite excluded nor included; we have the ſubject quite changed from what it was, a ſenſible concomitant heat and the product very near the ſame. I do not ſee more requiſite to eſtabliſh this animal proceſs to be of the ſame nature and in a certain degree of the proceſs of putrefaction.

Putrefaction, the moſt ſubtile of all diſſolvents, effectually diſjoins and ſeparates all the component parts of putrefying bodies, except ſea ſalt. In this powerful ſolution of bodies the inteſtine action of their minute particles creates, collects, or ſome way or other, is the cauſe or means of heat.

All our fluids are much diſpoſed to putrefaction, and out of the body, become highly putrid even in cool air, and without any ſtirring or agitation, and our blood and ſome of our juices out of the circulation, but within the body change to putrid matter.

This pus ſhews no high degree of putrefaction ſoon, yet if a very ſmall portion of it is abſorbed into the blood-veſſels, it raiſes a putrid fever as certainly as yeſt does a fermentation upon wort. This is not owing to its ſtimulating the ſolids to quicker and greater vibrations, but to its increaſing the inteſtine motion, and accelerating the animal proceſs; haſtening the change of the juices, to that ſubtile acrid ſtate, which renders them unfit to be retained in the body, and diſpoſes them to run off in colliquative evacuations, ſuch as ſweating and purging, which conſtantly attend theſe putrid or hectic fevers, which are owing to internal ulcers.

Now

Now if the warmth of our bodies can operate ſuch a change on a portion of our juices which is extravaſated; how reaſonable is it to conclude that the ſame heat makes a greater and quicker change on what is contained within the veſſels, ſince it is conſtantly moving on and every now and then meeting with new mixtures of heterogeneous bodies fit to excite new inteſtine motions? It is true that our circulating juices do not contract the ſame acrimony that the pus does. The reaſon of this is obvious, when we conſider our conſtant evacuation of acrid perſpirable matter, ſweat, urine, &c. and that as faſt almoſt as theſe noxious particles are formed, in the courſe of circulation they meet with various outlets, by which they are diſcharged before they can hurt us: In their way to the ſkin and other ſtrainers, they ſerve to maintain a moderate degree of heat (probably the true calidum innatum) enough to keep us warm, but not to create a conflagration to deſtroy us. Upon the ſtopping of theſe evacuations, we have dangerous fevers raiſed.

I have been aſked three queſtions, viz. Where this proceſs is tranſacted? When it commences? And, when it ends? To none of which I pretend to give ſatisfying anſwers; but ſhall wind up this eſſay by amuſing myſelf with the moſt probable conjectures that occur to me in anſwer to them.

As to the firſt, where is this proceſs carried on? It is moſt probable that it is proceeding conſtantly in all our juices, eſpecially where there is blood; and as there is three or four times more blood in the veins than the arteries, that this proceſs is chiefly carried on in the veins; and as the ſpecific coldneſs of the air in the lungs ſeems apter to check than to forward it, that there is leaſt of it in the lungs. Perhaps it proceeds faſteſt in the great veins, and particularly in that great reſervoir before the right auricle of the heart (the limits of which may be determined by the valves of the jugulars, azygos, ſubclavians, and iliacks,) which may be conſidered as a working-fat, where all the ingredients of refluous blood, lymph, chyle,

chyle, &c. mix and work together. The incomparable Harvey has ſeveral obſervations which favour this conjecture (a). There are likewiſe interſperſed in his works many paſſages which I think amount to a demonſtration, that the blood is both the fountain of heat, and the firſt ſpring of motion.

I ſhall treat the two laſt queſtions, when does this proceſs begin? And when does it end? in a looſe way together, and in the conjectural ſtrain. The animal proceſs begins as ſoon and continues as long as the ſyſtem itſelf, and there are various degrees of it in different periods.

I muſt begin by diſtinguiſhing betwixt the fœtus heat and the animal heat; betwixt the heat of a body newly dead, and that of a living one. There is a ſmall degree of warmth in the fœtus, which needs the aſſiſtance of the maternal heat to maintain it; and there is a warmth after death, which in ſome bodies laſts very long. Both theſe are ſmall degrees of it, but not the perfect animal heat itſelf, produced or cauſed by the animal proceſs.

I ſhall conſider the creature at firſt in the loins of the mother, and afterwards when arrived at a more perfect life. I imagine then, that from its firſt being

(a) Poſtquam cor & auriculæ a pulſatione quieſcebant, obſcurum motum & inundationem & palpitationem quandam manifeſtam ſuperfuiſſe. Exercit. 46. —— Sanguis in venis contentus (ſuo quaſi fundo) ubi copioſiſſimus (in vena ſcilicet cava) juxta cordis baſim & auriculam dextram, ſenſim ab interno ſuo calore incaleſcens & attenuatus, turget & attollitur (fermentantium in modum) unde auricula dilatata ſua facultate pulſifica ſe contrahens, propellit eum confeſtim in dextrum cordis ventriculum. p. 264. —— Diſtenſionis primam cauſam, calorem innatum, primamque diſtentionem eſſe in ſanguine ipſo (fermentantium in modum) ſenſim attenuato & turgente, in eoque ultimo extinctum puto. p. 275.—— Fit diaſtole in ſanguine ab interno quaſi ſpiritu intumeſcente. Quod enim in lacte ab igne calefacto, & cereviſiæ fermentatione cernimus, idem in pulſu cordis uſu venit; in quo ſanguis, quaſi fermentatione aliqua turgeſcens diſtenditur, & ſubſidit; quod ab interno calore ſive ſpiritu innato efficitur. Tract. de gen. animal. p. 150, 151.

a proper ſubject for our enquiries, however ſmall and inconſiderable it may appear, that ſomething of this proceſs has been going on in an inferior degree; and that it laſts even for ſome time after death. In the fœtus it is very imperfect, and not compleat till the animal can be called perfect: And what of it remains after death ſeems to be more incompleat, ſubſiſting in a ſubject which is no longer an animal at all. This warmth of the fœtus however needs that of the mother to maintain it, till the new ſource of heat comes to ſupply its place, by the commencement of the animal proceſs.

The animal proceſs commences, and the change of ſtate from that of a fœtus to that of an animal is made, when we come to breath freely; there is then more than one new circulation opened.

In the fœtus the lungs ſeem to be idle, there is no air for them to take in, and they tranſmit only a portion of the blood, the whole of which they are deſtined to receive afterwards. The liver hitherto has had little employment, for it comes lateſt to ſight of any of the viſcera; and the blood which returns from the inteſtines of the fœtus does not paſs through it, but through the umbilical vein directly to the heart; there is bile in the gall bladder, and biliary ducts, but much of it has not been poured forth. As the alantois is undetermined, whether there is ſuch a reſervoir in the human ſubject, and in brutes, the collection during the whole months of geſtation amounts to ſo ſmall a matter, that the kidneys have had little to do. Moſt of the glands are vaſtly large in proportion to the other parts, and have all their receptacles full. The ſtomach and guts are full; and the lymphatick ſyſtem, the lacteals, receptacle of the chyle and thoracic duct are pretty much in the ſame condition, all full and ready to diſcharge themſelves. In this ſtate the fœtus is ſhaken off from its mother, and muſt ſubſiſt by itſelf; nature has furniſhed it with a variety of different organs, for receiving nouriſhment, for tranſmitting, perfecting and applying it.

All

All this machinery, moſt of which has hitherto in great meaſure been at reſt, is ready to play off, when the creature is thruſt into the open air. What follows? In a few moments it begins to gaſp and pant, the cheſt heaves, the diaphragm preſſes down, the lungs fill with air, the thorax is diſtended, and the belly is ſqueezed. Immediately afterward the abdominal muſcles contracting, return the force impreſſed on them; and by their re-action, the cavity of the breaſt is ſtraitned, and the air driven out in infant cries. Then and not till then I allow it to be an animal.

Some of the effects of theſe early motions are ſoon viſible, and it is reaſonable to conjecture that many more of them happen, though they are out of ſight. The ſtomach and inteſtines begin to diſcharge their loads, and ſometimes the urine ſtreams forth, as the child is carrying from the mother; and I imagine from the liftings, pantings, heavings of the new born creature, that not only the blood takes its new courſe through the lungs, but that the glandular and lymphatic ſyſtems are let looſe, the chyliferous veſſels, and Pecquet's duct fully opened; their contents ruſh through the ſubclavian vein into the ciſtern above mentioned, a new mixture and a new circulation commences. As a counterpoiſe to theſe, the external air may be a ſort of equilibrium; and to this reciprocation the animal proceſs and continuation of animal life may be owing.

As to the end of this proceſs or death, it is generally taught, that the life of thoſe animals, which we call perfect, conſiſts in a continued flux and reflux of blood, nervous juice and air to and from the principal organs; and that (death being a ceſſation of theſe) a man may be reckoned dead when he no longer breathes, and his heart and arteries have left off all circulation and pulſation. Even Lanciſi, who wrote beſt on this ſubject, ſays, that without a ſmall degree of reſpiration and ſome little motion or trembling

bling of the heart, there is no life (*a*). In conſequence of this ſyſtem, the general practice is, that as ſoon as theſe ſymptoms of life are gone, all hopes and all endeavours to maintain and foſter the ſmall remains of life, are laid aſide; and the ſubject is conſidered no longer as an animal, but a corpſe.

I cannot away with this doctrine, and abhor the practice built on it; being of opinion that after the motion of the heart, arteries and lungs ceaſes, there often remains a ſmall degree of a vital principle, but ſuch a degree as well merits attention, the neglect of which has had many woful conſequences. After a full ſtop of all thoſe organic motions on which life is ſaid to depend, the juices frequently retain ſo much of the animal proceſs, as in many inſtances ſerves to maintain warmth for a long time; and in others with proper cheriſhing might reſtore life entirely. Every age and country afford inſtances of ſurpriſing recoveries after lying long for dead; and among ourſelves we have had ſome, who have lived years after being actually buried. From the number of theſe who have been preſerved by lucky accidents (for moſt of them owed not their reſtoration to either art or care) we may conclude that there muſt have been a far greater number of thoſe who might have been ſaved by timeous pains and ſkill, and who died a death which cannot be thought on without horror.

Such uncommon recoveries are generally accounted for, by ſuppoſing that there remained, during the whole time of the appearance of death, ſome little motion of the center of the diaphragm, by which a ſmall degree of reſpiration, though imperceptible to the ſpectators, was continued; and ſome little trembling of the heart, receiving and emitting a ſmall portion of blood, though not with a pulſe ſtrong enough to be felt, yet ſufficient to preſerve the vita minima.

Our theory gives hopes that one who from all theſe motions ceaſing may be with propriety called

(*a*) De ſubit. Mort. p. 74.

dead,

dead, may recover them, and properly be ſaid to come alive again. It is ſhortly this. The cauſe of animal heat, or of the inteſtine motion which had been going on proſperouſly, while the progreſſive motion of the fluids in the veſſels continued is now checked, yet ſtill proceeds in a lower manner, perhaps like the beginning of fermentation or putrefaction. By this degree of the animal proceſs, the maſs of fluids particularly in the great reſervoir of venous blood, &c. before mentioned, rarifying, preſſing every way, and being reſiſted by the valves, ſwells ſo as to fill the flaccid right auricle of the heart, which had been ſome time empty, and thus ſtimulating its fibres, which were at reſt, ſets them a moving again (as we ſee the heart, after being taken out of the body, by being pricked, or having warm water thrown on it, beats afreſh, though it has been for ſome time motionleſs.) The right auricle being thus filled, and ſtimulated into a contraction, fills the ventricle; which being irritated likewiſe contracts, and empties itſelf into the pulmonary artery; whereby the circulation begins where it left off, and life is reſtored, if the organs and juices are in a fit diſpoſition for it, as they are perhaps much oftner than is imagined (*a*).

This theory will ſeem probable to one who knows, that, in death, firſt the left ventricle loſes its motion, and then its auricle, and laſt of all the right auricle ceaſes to move; that after all theſe are at reſt, there remains in the blood itſelf, before the right auricle, a certain trepidating, palpitating, undulatory motion (*b*) like that of fermenting liquors. Now it ſeems agreeable to nature that this motion (which I take to be the ſame with that intromoventis naturæ energia, by which Lanciſi ſays ſome have been reſtored to

(*a*) As this obſervation of the truly ingenious author appears of the utmoſt importance to mankind, the reader is particularly deſired to turn to a moſt remarkable caſe related in vol. v. art. 55. which ſeems greatly to ſupport the opinion here delivered. The hiſtory here referred to has been lately communicated afreſh to the royal ſociety, that by this means, it might, and deſervedly, be more taken notice of by the world.

(*b*) Harv. Exercitat.

(life

life) ſhould be accompanied with ſome degree of rarefaction; the unavoidable effect of which is to preſs upon and ſtimulate the right ſinus venoſus and auricle while it inſinuates liquor into them: And ſeems to be all that is neceſſary to recommence the intermitted circulation.

How long our fluids may retain a fitneſs for this rarefaction, before it exerts itſelf fully, and how long our ſolids may continue ſuſceptible of a new ſtimulus, is well worth enquiring into. Theſe may depend on the preceding diſpoſition of the blood, the temperature of the ambient medium, and many other things. That in ſome they may continue a long time, and the body not ſpoil, may be inferred from other proceſſes; ſuch as fermentation, where we ſee muſt continue a long time in a cloſe caſk, ere it gives any ſign of rarefaction: It might be inferred from the inaptneſs of ſome animal juices to freeze, in a degree of cold far greater than that in which water freezes and from human blood's continuing fluid in the veſſels many days after life is gone. Authors and nature would ſeverally ſupply me with arguments to render this way of thinking more feaſible, but I ſhall drop them all, and conclude this article about the end of the proceſs by declaring my opinion, that death does not inevitably attend an entire organic reſt of what we call the ſolids of the body, nay that one cannot be called dead till the energy of the blood is ſo far gone, that though aſſiſted by all poſſible means, it can never be able again to fill, and ſtimulate into contraction, the right ſinus venoſus and auricle of the heart.

I ſhall now endeavour to render ſomewhat more familiar to us the uncommon ideas which we have advanced in conſidering the fœtus and animal ſtates, as well as that of death. I chiefly fix on that period, or pauſe ſhall I call it, in the life of ſome animals, which goes by the name of the benummed ſtate, and conſider the analogy betwixt it and ſome vegetables. Many plants on the approach of winter, ceaſe gradually from all the functions of vegetable life; they breath no more through the leaves (which are a ſort

of lungs to them (a);) they take no more nouriſh-ment, ſeem to die, and continue dead to appearance, till the vernal ſun revives them. This carries a near reſemblance to what happens annually to Bears, Marmotes, Dormice, Bats, Hedge-hogs, Swallows, and the other animals called Sleepers. All winter they do not feed, have no ſenſible evacuations, breath little or not at all, and moſt of the viſcera ceaſe from their functions. Some of theſe creatures ſeem to be dead, and others to return to a ſtate like unto that of the fœtus before birth: In this condition they continue, till by length of time maturating the proceſs or by new heat, the fluids are attenuated, the ſolids ſtimulated, and the functions begin where they left off.

To aſſiſt us in diſcovering ſomething of the nature of this change into a ſtate where there remain few traces of animal life, and even little or no circulation or reſpiration, and which in many particulars very much reſembles our own deaths, I ſhall point out three obvious things, which have the moſt ſenſible influence on the two laſt named functions; theſe are diet, exerciſe and air.

As to the firſt, the pulſe beats higher and quicker, and the reſpiration is more frequent and large, after feeding; and this in proportion to the quantity of new chyle which enters the blood. On the other hand, after long faſting, the pulſe is lower and ſlower, and the lungs have ſo little play, that the reſpiration is hardly to be perceived, if there is no other ſtimulating cauſe acting at the ſame time.

Secondly, muſcular motion quickens the circulation of the blood, and that in proportion to the vehemence of it. Lying quiet in an eaſy poſture, where feweſt muſcles are employed, the pulſe is ſloweſt; ſitting it riſes a little; ſtanding and walking, yet more and more; and running raiſes a fever for the time. I need not repeat the ſame things of reſpiration, which is influenced pretty much in the ſame way, in proportion to the number of muſcles acting, and the violence of their contractions.

(a) Hales's Vegetable Statics.

Thirdly

Thirdly, theſe functions depend much on the temperature of the atmoſphere. In a hot air our inſpirations are more full and frequent, and our blood ſwelling, circulates with more violence. In a cold air, we breath ſeldomer, and with leſs diſtenſion of the cheſt; and, the blood ſubſiding, the circulation is calmer.

If we take a full view of the influence which theſe three have upon the moſt important animal functions, from the foregoing obſervations we may conceive what happens to the Sleepers, and that there may be ſtill greater effects of a concurrence of theſe three in ſuch animals (whoſe juices perhaps differ from ours, eſpecially at certain ſeaſons, being fitted by nature to their neceſſities) and that a creature receiving no new chyle at all, making no loco-motion, and being in a cold place in a cold ſeaſon, may ſubſiſt without reſpiration, and perhaps with little or no circulation, and return either to a ſtate in many things reſembling that of a fœtus, or to one a-kin to that of the vegetables above-mentioned in winter, or near to that of a man who ſeems dead, or is really ſo for the time, but retains a principle of reviviſcence.

From what has been already ſaid, I hope I may be allowed to conclude, that, ſince it has never been demonſtrated, that any fluid acquired heat in the coarſe mechanic way, by friction with a ſolid body; or that ſo conſiderable a change was made on the ſtructure of the mnute parts of bodies, as is made in this proceſs without producing heat at the ſame time: Since in fermentation, putrefaction, &c. the heat is not pretended to be owing to the veſſels containing the changed ſubject, but to what happens to its minute parts in undergoing that change: Since theſe things are ſo, I ſay, I may conclude that it ſeems an unphiloſophic partiality for the mechanics to maintain, that our juices have all their heat communicated to them from the ſolids, and acquire it by rubbing with the veſſels. I ſhall end with a conjecture propounded in theſe ſhort queſtions.

Q. 1. Since there are proceſſes, in which mixtures will not efferveſce, without being ſhaken or ſome how moved; may not this animal proceſs be ſomewhat of that kind, owing only its going on proſperouſly to the circulatory motion as a condition ſine qua non?

Q. 2. Since there are proceſſes in which mixtures maintain an efferveſcence, while there is a conſtant addition of ſome one or other ingredient, to keep up the heterogeneity of the mixture; and when that new infuſion ceaſes, the inteſtine motion ceaſes alſo; may not this proceſs be of that kind? Or,

Q. 3. May it not be a compoſition of both kinds?

Of the hot and cold pediluvium.

THE uſes of warm bathing in general, and of the pediluvium in particular, are ſo little underſtood, that they are often prepoſterouſly uſed, and ſometimes as injudiciouſly abſtained from. The common theory, however plauſible it appears, will not ſtand the teſt of a thorough examination. This is of very bad conſequence, as it is generally received and built upon in practice. To bring the matter to a ſort of demonſtration, in a cool evening, October 2, before ſupper, I cauſed two youths, the one of the age of fourteen years, the other of thirteen, both ignorant of the purpoſe of the experiment, to put their legs in warm water; after examining their ſkins, the ſize and the colours of the veins in their hands and faces; while they continued in the pediluvium, I counted their pulſes exactly by a watch meaſuring ſeconds, and obſerved,

That at 8 o'clock, immediately after the immerſion to the gartering below the knee, in milk-warm water, their pulſes beat in a minute, the firſt 66, and the ſecond 84, as before immerſion. At fifteen minutes after eight, the water a ſmall time before being increaſed in heat, though not to the degree of the warmth of blood; the ſecond yawned and began

gan to breath quicker: Their pulſes then beat, the firſt 69, and the ſecond 88. About twenty five minutes after eight, the water being made full blood-warm, the veins of their hands were greatly ſwelled; the ſecond had his face fluſhed; their pulſes beat, the firſt 75, and the ſecond 94. At thirty five minutes after eight, both of them had the veins of their faces and hands very much diſtended; the firſt ſaid he was greatly diſpoſed to muſing; the ſecond was ſleepy with his face ſo red that I was afraid of hurting him, by purſuing the experiment any further: Both their pulſes, which in the beginning were ſoft and ſmall, became very full and hard, the firſt eighty, and the ſecond ninety-eight in a minute. Then I made them put their feet on a carpet, ſitting ſtill without any motion, as they had done before, and reckoned their pulſes, which at forty minutes after eight beat, the firſt ſeventy-one, the ſecond ninety; and at forty-ſix minutes after eight their pulſes became leſs and ſofter, beating, the firſt ſixty-nine, the ſecond eighty-eight. A little after nine, the fluſh was off the ſecond's face, and their pulſes were become quite ſoft and ſmaller, the firſt ſixty-ſix and the ſecond eighty-five, almoſt as they ſet out.

This gives a true explication of the manner whereby hot bathing operates, and demonſtrates that the diſtenſion of the veſſels is owing chiefly to the rarefaction of the contained fluids.

My opinion of the warm pediluvium is this, notwithſtanding the opinions of Borelli, Boerhaave and Hoffman to the contrary. The legs becoming warmer than before, the blood in them is warmed; this blood rarifying, diſtends the veſſels; and, in circulating, imparts a greater degree of warmth to the reſt of the maſs; and as there is a portion of it conſtantly paſſing through the legs, and acquiring new heat there, which heat is, in the courſe of circulation, communicated to the reſt of the blood; the whole maſs rarifying occupies a larger ſpace, and of conſequence circulates with greater force. The volume of the

blood being thus increaſed, every veſſel is diſtended, and every part of the body feels the effects of it; the diſtant a little later than the firſt heated ones.

The benefit obtained by a warm pediluvium is generally attributed to its making a derivation into the parts immerſed, and a revulſion from thoſe affected, becauſe they are relieved; when the cure is performed by the direct contrary method of operating, viz. by a greater force of circulation through the parts affected, removing what was ſtagnant, or moving too ſluggiſhly there.

Warm bathing is of no ſervice where there is an irreſoluble obſtruction, (though by its taking off from a ſpaſm in general, it may ſeem to give a moment's eaſe;) nor does it draw from the diſtant parts, but often hurts, by puſhing againſt matter that will not yield, with a ſtronger impetus of circulation than the ſtretched and diſeaſed veſſels can bear: So that where there is any ſuſpicion of a ſchirrus, I would never order warm bathing of any ſort.

On the other hand, where obſtructions are not of long ſtanding, and the impacted matter is not obſtinate, warm baths may be of great uſe to reſolve them quickly. In recent colds with ſlight humoral peripneumonies, they are frequently an immediate cure. This they effect by increaſing the force of the circulation, opening the ſkin, and driving freely through the lungs that lentor which ſtagnated or moved ſlowly in them. As thus conducing to the reſolution of obſtructions, they may be conſidered as ſhort and ſafe fevers; and in uſing them we imitate nature, which by a fever often carries off an obſtructing cauſe of a chronical ailment. Borelli, Boerhaave and Hoffman are all of opinion that the warm pediluvium acts by driving a larger quantity of blood into the parts immerſed. But arguments muſt give way to facts. The experiment above related proves to a demonſtration that the warm pediluvium acts by rarifying the blood, which is further confirmed by the following caſes.

A

——————— In a fever with a head-ach, without any delirium or other threatning ſymptom, had his legs put into hot water: At firſt he ſaid it was very agreeable, then he ſpoke much, and in half an hour became quite delirious, and continued ſo till next morning, when he died. This was imputed to a too ſtrong revulſion, which had not left that force of circulation through the head, which was neceſſary to maintain the functions; but it is more probable that his death was owing to a greater impetus on the brain than it could bear.

A ſober matron by putting her feet into warm water, had a delirium, as if ſhe had drunk champaign to exceſs: A young nobleman, after going into a warm bath, appeared like one drunk, and a little after like one quite mad. Both recovered as ſoon as they became quite cool.

The warm pediluvia, when rightly tempered, may be uſed as ſafe cordials, by which the circulation can be rouſed or a gentle fever raiſed; with this advantage over other cordials and ſudorifics, that the effect of them may be taken off at pleaſure.

The rarefaction of the blood is the moſt important conſideration in this method of cure, yet far from being the only one: I ſhall paſs over the reſt ſlightly, being pretty fully treated by Galen, whoſe reaſoning upon them, with little alteration, has continued down to this day.

Opening the pores by ſoftening and relaxing the ſkin, humectation of the body by imbibed water, taking off a ſpaſm and eaſing pain; theſe with revulſion from diſtant parts, ſeem to be the chief topics inſiſted on. To the laſt of theſe I need ſay nothing further.

No doubt warm baths ſoften and relax the ſkin, which may be of conſiderable uſe in clearing the pores, and forwarding the perſpiration of the immerſed parts; but this cannot be of great conſequence, when the legs only are bathed, for their ſurface bears only a ſmall proportion to the reſt of the body. And in the ſmall

pox, where ſo much is expected from them, I think, their frequently tumultuous operations render them ſuſpected, and at beſt of very doubtful effect. I prefer Monſ. Martin of Luſanne's method of bathing the ſkin not only of the legs, but of the whole body, with a ſoft cloth dipt in warm water, every four hours till the eruption; by this means the puſtules may become univerſally higher, and conſequently more ſafe.

As to the humectation of the body, by water mixing with the blood, it may be in part true, but there is too much imputed to it. To this is attributed the ſwelling and increaſed fulneſs of the body in general, which we have ſhewn to be owing to another cauſe, viz. the rarefaction and attenuation of the blood; which may be produced almoſt as readily by heat without moiſture. Nay further, I doubt whether the body in a pediluvium imbibes more than it loſes; conſidering that the emitting or perſpiring veſſels are dilated as well as the admitting ones; and that there is now a greater force of circulation driving outward, enough to over-balance the additional weight of water; which I purpoſely omitted in enumerating the effects of this method of cure, becauſe it ſeemed inconſiderable when the legs only were bathed. Some of the phænomena which ſeem to favour the dilution of the blood by a quantity of water imbibed through the ſkin, ſuch as the running of the noſe, and quenching of thirſt may be accounted for in another way; for the increaſed force of the rarefied and attenuated blood making a more forcible circulation through the ſchneiderian membrane and ſalival glands, may thin and increaſe the quantity of mucus and ſaliva; whereby the noſe runs, and the drought is quenched.

In violent pains hot and cold bathing produce the ſame effects, and in the ſame way in one reſpect, viz. aſſwaging the pain by taking off the attention from it. When one is much pained, withdrawing the action of the nerves, correſponding to the affected part, employing many nerves, or ſome of them violently another

another way will ſeldom fail of giving eaſe. One pain is commonly a cure for another. Applying garlick to a diſtant part, burning and bliſtering, cure all in this way.

Thus far the hot and cold pediluvium have the ſame effects; in other reſpects they differ widely, and have generally quite contrary ones.

A gentleman twenty ſeven years of age, naturally not coſtive, from catching cold, as he imagined, July 7, 1739, complained of a ſlight pain of his breaſt, ſtomach and guts, and uneaſineſs from coſtiveneſs; he tried ſeveral medicines of his own; but, growing daily worſe,

On the tenth and eleventh, lenitive and purging clyſters, laxative ptiſans, ſolutions of manna and of ſalts, boluſes and pills of different ſtrengths and kinds, were adminiſtred. The eleventh at night, I found him rendering his clyſters as they were injected, without any fœces, vomiting every thing taken by the mouth, reſtleſs and greatly pained from the navel to the os pubis. That night, to ſtop the vomiting, ſalt of wormwood, with juice of lemon, was given, and to open his body, tinctura ſacra. He threw up all his medicines ſoon after they were taken, and continued to vomit every thing he drunk through the night. He had no ſleep, and was crying out with the violence of the pain of his lower belly. His pulſe being a little fuller, and more frequent, he was bled plentifully. To ſtay the vomiting, without which nothing could be done to purpoſe, he took every half hour two ſpoonfuls of a ſtrong tincture of dry mint, in good ſimple mint-water. This ſettled his ſtomach, as it ſeldom fails to do. To procure a paſſage downwards, every hour one pill of equal parts of ſoap and aloes was given, with two ſpoonfuls of the tincture of mint, to prevent his throwing them up. This day he took ten pills, had fomentations and clyſters repeated; was in a warm bath, and had a lamb's ſkin hot from the animal applied to his belly; but all in vain; the conſtipation of the bowels continued obſtinate; the hypogaſtrium became ſwelled and hard, and his pain almoſt beyond human ſufferance. The thirteenth he continued without ſleep, or a moment's

eaſe,

eaſe, ſweating frequently, and crying out with the inceſſant torment of his guts. He continued the ſoap and aloes pills every hour, till he had taken twenty three, all which he retained; as likewiſe a ſolution of manna in whey; but nothing paſſed. In the afternoon he was again let blood, and clyſters of a decoction of prunes, with four ſpoonfuls of ſweet oil were injected. At night he ſwallowed a bolus of ſweet mercury; three hours after which, he threw up every thing he had taken, and his caſe was looked on as deſperate, the fever increaſing, and the agony being grown intolerable.

On the fourteenth, after he had paſſed a miſerable night, without ſleep, in the moſt extreme pain, when there appeared no hopes from any of the common methods the cold pediluvium was tried. He was carried into a cold room, with his limbs naked. Every ſecond minute, a porringer of cold water was daſhed on him, beginning at his feet, and riſing gradually, till toward the end of the operation it was thrown as high as the pubes. We made him ſometimes walk about, ſometimes ſtand on the cold wet floor, and frequently plunge his feet alternately in a tub of cold water. He found ſoon that this gave him ſtrength, and proved rather comfortable than diſagreeable, for near half an hour: Then he began to cry out as before, vomited once, was fatigued, and complained bitterly of his belly being more ſwelled than ever, and of very ſharp gripes. Immediately after this, at the end of thirty-five minutes, he purged on the floor, before he could be got to the ſtool, where he had a large liquid evacuation, with ſome little indurated fœces. He went to bedmuch relieved; but ſtill uneaſy with the ſoreneſs of the parts, and the remainder of ſo great a load. In the afternoon an emollient clyſter was adminiſter'd, along with which he evacuated ſome hard excrement. At eight in the evening we gave him a doſe of tinctura ſacra, and thirty drops of liquid laudanum. About midnight he purged a great deal, a conſiderable ſhare of which was indurated ſtuff. On the fifteenth we found the opiate had procured him ſome ſleep. He had four ſtools before we ſaw him in the morning. The

ſtrained and ſore part of the gut continued uneaſy, and his fever ſtill pretty high; but his belly was become quite ſoft. He continued to take pills of ſoap two parts, and aloes one, for ſome hours. At laſt, after having been full ſix days without one grain of food, he got every now and then two ſpoonfuls of chicken broth, or one of panado, and drank a little ſack-whey, or common whey, till the evening, when his drink was changed to an Arabic emulſion, ſweetned with ſyrup of violets. He paſſed a good night without any anodyne, and had three or four motions, preceded by ſharp gripes.

The ſixteenth in the morning he was leſs feveriſh, and much eaſier. The ſame food and liquors were continued thro' the day. He had two or three ſtools with gripes, which were ſucceeded by a good night's reſt. In the morning of the ſeventeenth, he had one very copious diſcharge, in which there were hard fæces of the old remains. After this he became quite eaſy, his fever going off, as it does commonly the third day after the body is opened.

I ſhall now give the reaſons which induced me to propoſe, and the gentleman to ſubmit to ſo uncommon a practice. The reaſonableneſs, at leaſt the feaſibleneſs of this method of cure, will, I hope, appear, upon reflecting on the following few looſe hints, the application of moſt of which is ſufficiently obvious.

There is nothing more common than colic pains, and purging from cold wet feet. On a ſudden check of the perſpiration, the perſpirable matter frequently brings on a diarrhœa: This has an advantage which neither purgatives taken by the mouth, nor clyſters have, or can have; for either of theſe can act only on one end of the hard excrement, with which the gut is in a manner corked; whereas the matter of the Sanctorian perſpiration, checked by the external cold, ruſhing into the cavity of the inteſtine betwixt it and the fæces, may at once lubricate the paſſage, diſſolve part of the hard contents, and ſtimulate the gut to forward the diſcharge. In the ſmall-pox and other fevers, when there has been a long retention of urine,

patients

patients get relief, from ſetting their feet on the cold ground. As cooling the feet forwards both the ſecretion and excretion of urine, it may have a ſimilar effect on the bile. Moſt people incline to make water, and many are diſpoſed to go to ſtool, on putting their feet into cold water, or even waſhing their hands with it; from a ſort of tremor, ſhock or ſtimulus induced on the nerves; taking off ſome inertia or ſluggiſhneſs of the membranous ſyſtem of the guts and bladder, which had diſabled them from throwing off their loads. From what I have obſerved on opening the bodies of ſome who have died of a conſtipation, and the ileus itſelf, I am apt to believe that frequently theſe ailments are, firſt or laſt, owing to or attended with, a kind of palſy of the inteſtines, to be cured by fomenting the belly with wine, in which aromatics have been boiled, and drinking a little of the ſame when the pulſe is ſlow, and the body cool; or in this way by the cold water, when the patient is inclined to be hot or feveriſh. By putting the feet into cold water, the whole body is cooled; and the blood chilled by this operation, occupying a leſs ſpace in the coats of the inteſtines, may allow of an eaſier ſecretion into their cavities: And if a conſiderable quantity of air in the guts, conduces to the diſeaſe, by this coldneſs it may be condenſed, and the inteſtine hitherto ſtrained by its rarefaction, now contracting, may be better able to perform its office. The cold bath is the beſt cure of that difficulty of making water, which is cauſed by a too long retention of urine. Immerſion in cold water was uſed by the antients in ardent fevers; and it has been practiſed even in this cold climate without any bad conſequences; particularly by a hardy empiric on his mother, a lady well ſtricken in years, with notable ſucceſs.

I might add ſome caſes a-kin to the one I have ſet down at large, in which the ſame practice was attended with very good effects (ſuch as eaſing pain, giving ſtrength, carrying off the ſickneſs and vomiting, &c.) even where it did not procure a paſſage immediately. But I ſhall content myſelf with ſubjoining a very extraordinary

traordinary one; not on account of any affinity betwixt the diſeaſes, but becauſe the ſurpriſing efficacy of this application in opening the body, appears in it.

——— Laurence, about forty five years of age, after a ſlight intermittent, which was carried off by a vomit and a few bitters, was ſeized with an obſtinate conſtipation, which laſted from the 27th of September, to the eighth of November following, before a ſtool could be procured; which at laſt was obtain'd by the following experiment. About noon, a clyſter of water-gruel, with two ounces of ſoft ſoap, was firſt injected; in a quarter of an hour after, I ordered him to be taken out of bed, ſtripp'd to the middle of his thighs, and to be led about the room. At which time I daſh'd his legs and thighs with cold water, which ſurpriſed him much, and ſenſibly ſhocked the whole habit. About the tenth minute from the firſt ſprinkling, he began to drop ſome excrement; at the ſeventeenth minute, a tolerable ſtool came away, rather ſoft than hard. Finding him at this time weak and fatigued, I order'd him to be wiped dry, put to bed, and a porringer of warm broth to be given him, and that he ſhould be covered up cloſe. He continued in this way 'till ten o'clock at night, when he had another ſtool, ſucceeded by two more involuntary ones before morning, the whole making a conſiderable evacuation. Through the whole of this caſe, the patient had no complaint of pain, no vomiting, but an extraordinary groſs evacuation by urine, of a chocolate colour. Sometimes he would take his nouriſhment pretty well, at other times obſtinately refuſe it. All along he ſeemed to be ſtupid, and is at this time very emaciated and weak.

An eſſay on the alternate motions of the thorax and lungs in reſpiration. By Dr. GEORGE MARTINE, *Phyſician at St. Andrew's.* Vol. I. art. 12.

THE mechaniſm whereby in ordinary life, inſpiration and expiration ſucceed one another alternately, has not been ſatisfactorily explained or accounted

accounted for, either by Swammerdam, Borelli, Bellini, Pitcairn, or Boerhaave. This made me almoſt deſpair of giving any true and juſt account of a phænomenon ſo obvious, but ſo difficult to be explained; until at length, meditating upon the riſe and ſingular courſe of the nerves of the diaphragm, I thought I could perceive a neceſſity of their being alternately compreſſed, and again ſet at liberty, ſo as to produce an alternate contraction and relaxation of that muſcle.

The diaphragm is the chief organ of reſpiration; to its depreſſion evident from the ſwelling of the belly, the enlargement of the cavity of the breaſt is more owing than to any remarkable change in the poſture of the ſternum and ribs. If we conſider the origin and courſe of the nerves of this muſcle, we ſhall be able to account for the alternate motion in reſpiration, as far at leaſt as it depends upon the motion of the diaphragm. They ariſe from the middle cervical nerves, and are conveyed by a long paſſage through the cavity of the breaſt to the diaphragm.

The external air then gravitating equally; and therefore preſſing upon the hollow ſurfaces of the pulmonary veſicles, and conſequently upon the membrane inveſting the lungs: by the mediation of this coat of the lungs, that preſſure of the air ſhould be propagated to the membrane lining the thorax. But now at the end of expiration, the thorax being collapſed, conſider the natural contractility of the membranes, and fibres of the animals, and the reticulated work of muſcular fibres ſurrounding the lungs, and every way pervading and ſtrengthening this ſubſtance, and you will conceive how the contractile pulmonary membranes and fibres will, by their re-action, in ſome meaſure ſupport the action of the inflating air; which therefore cannot preſs with its whole force upon the pleura: ſo that in this ſuppoſed moment of time, at the end of expiration, the preſſure of the air upon theſe nerves muſt be leſs than upon the other parts of the body, to which the atmoſphere has a

freer acceſs. Whence the liquor of the nerves, or whatever influence is communicated by them, muſt find a more free paſſage to the midriff, whereby it immediately contracts itſelf, and by the enlargement of the thorax inſpiration commenceth. During the courſe of which, theſe nerves continue freer from compreſſion, by the inflation of the lungs ſtretching more and more the contractile pulmonary fibres, which therefore do more and more ſupport the preſſure of the atmoſphere.

After expiration, inſpiration muſt neceſſarily ſucceed, till the thorax ſhall have acquired its ordinary enlargement, by the natural and ordinary depreſſion of the diaphragm. Then the air being rarified by the heat of the breaſt, and not finding a free enough exit by the narrow ſlit of the glottis, will preſs every way the lungs; which preſſure will be forcibly propagated to the containing pleura, and to the phrenick nerves. Hence their influence muſt ceaſe, and the diaphragm be relaxed, and reſpiration ſucceed by the ſpontaneous reſtitution of the over-ſtretch'd peritonæum and abdominal muſcles: For theſe compreſſing their contained viſcera, muſt puſh the midriff into the thorax, and ſo compreſs the lungs more forcibly than their own natural contractility. Thus then the preſſure of the lungs upon the pleura and phrenic nerves muſt ſubſiſt all the time of expiration, untill at its end every thing come to a ſtate of æquilibrium; wherein the contractility of the lungs bearing off ſome ſmall part of the preſſure of the atmoſphere from the pleura, the ſpirits find a free paſſage thro' the phrenic nerves, the diaphragm is contracted, and the air inſpired, which very ſoon comes to be expelled in the manner juſt now expreſſed.

But ſince beſide the action of the midriff, the figure and capacity of the thorax ſuffers a conſiderable change in reſpiration, by the contraction chiefly of the intercoſtal muſcles, and that eſpecially in women; the next ſtep ſhould be to conſider the condition of the nerves belonging to theſe muſcles; whereby from an alternate compreſſion, or ſome ſuch mechaniſm, the

muſcles

muſcles may ſuffer an alternate contraction and relaxation.

Theſe nerves, even before they are received between the double row of intercoſtal muſcles, are ſo well defended by the tenſe and firm pleura covering them at the ſide of the ſpine, that the variety of the preſſure of the lungs muſt have much leſs influence on them, than upon the phrenics; and conſequently the intercoſtal muſcles cannot be ſatisfactorily explained in the manner abovementioned, perhaps for want of being perfectly acquainted with every minute circumſtance relating to the ſtructure of theſe muſcles, and of the blood-veſſels and nerves belonging to them.

From the foregoing doctrine may be underſtood, why a fœtus in the time of geſtation, never dilates its thorax, nor at any time before the birth, performs even ſlowly the motions of inſpiration and expiration ſucceſſively. In geſtation, while the fœtus continues envelop'd in the ſecundines, and immerſed in the colliquamentum amnii, the phrenic nerves are too much compreſſed to allow a free paſſage of the ſpirits to the diaphragm; but as ſoon as the animal enjoys the external air from the leaſt motion of the breaſt, the phrenic nerves which were formerly compreſſed by the lungs, have a part of that preſſure taken off, and being at more freedom, will contract the midriff, which being once ſet a going, will for ever ſuffer an alternate contraction and relaxation. while the animal continues in life and health.

An eſſay concerning the analyſis of human blood, by Dr. GEORGE MARTINE, *Phyſician at St. Andrew's.* Vol. II. art. 7.

I. *The blood a heterogeneous maſs.*

THE blood which in its eruption from the veſſels, appears an uniform red liquor, is compoſed of particles, differing as greatly from one another, as the variety of ingredients of which it is made

up, or as the various forms it aſſumes in the animal machine. Hippocrates (a) from the various effects of different medicines, and from ſome particles diſplaying themſelves in a morbid ſtate, inferred the prior exiſtence of diſſimilar particles in the blood, although in a ſound ſtate, they do not ſenſibly diſcover themſelves.

II. *Its compoſition according to the ancients.*

2. The moſt obvious compoſition of the blood is of a thin watery liquor, and a thick reddiſh lump, into which it readily ſeparates (b), upon its emiſſion out of the body, throwing off at the ſame time a volatile ſmelling ſteam (c). The red part the ancients looked on as the true proper blood (d). The redneſs of the muſcles and other parts they reckoned the effects of a greater quantity of theſe red particles, which conſtituted the firſt and chief element of the whole maſs: And they ſuppoſed the watery liquors (e), ſeparated from the kidneys and ſkin, and in other parts of the body, to be the product of the ſerum of the blood, and ſo the phlegm came to be the ſecond element. And obſerving this commonly of a yellowiſh colour, and finding a conſiderable quantity of bile of that hue to be ſecerned from the blood, they concluded it to be the product of theſe particles tinging the ſerum, and another element of the ſanguineous maſs. This too they thought frequently to be ſecerned by medicines, which therefore they called cholagogues. And laſtly, becauſe the under part of the craſſamentum is generally of a dark colour, they reckoned it to be of the ſame nature with the liquor of the ſpleen, and the black-

(a) De vet. Med. xxiv. De nat. hum. v. vi. viii.

(c) Helmont. op. p. 577. Cornel. progymn. phyſ. 7. p. 290. Malpigh. de polyp. cord. p. 130. Bellin. opuſc. ad Pitcarn 39. p. 192.

(b) Galen. de Elem. 1, 2. De melanch. 11. Avicen. lib. 1. Fen. 1. doct. iv. cap. 1. p. 23.

(d) Hippocrat. de Gland. 1, 6.

(e) Vid. Galen com. in iii. epidem. 1. 5.

iſh liquors thrown out of the body by vomit or ſtool: And ſuch they called black bile, which they reckoned as the fourth element of the blood. And this doctrine of the compoſition of the blood, as made up of theſe four elements, was moſt carefully cultivated, and the theory and practice of medicine adapted thereto in all times, from the days of Hippocrates, till the laſt age, when it began to give way to principles of another kind: The chemiſts ſet up a laboratory, and the philoſophers and mathematicians introduced their diagrams into the animal ſyſtem.

3. From the blood are produced phlegm, bile, and what the ancients called melancholy, and conſequently all theſe exiſt, at leaſt virtually, in the blood, and ſo may we ſay of the ſaliva, &c. and of the arteries, bones, &c. but not infer that all theſe did formerly exiſt in the ſame form, as elements or principles thereof. What a great ſhare of their preſent form and appearance do theſe various liquors and particles owe to the action of the organs, to which they belong, and to the various combinations and circumſtances they undergo?

III. *The chemical analyſis of the blood.*

4. The firſt philoſophers (a) repreſented the human blood as the product of air, ſome as of fire, ſome as of water, and others as of earth; and ſome thought it was (b) an aggregate of theſe elements blended together. But the chemiſts pretended to put the compoſition of the blood beyond diſpute. By diſtillation they reſolved it into water, ſulphur, ſalt, and earth, and theſe they affirmed to be the true principles of which it is compounded.

5. But all we can juſtly conclude from their experiments, is, That the blood upon ſuch a heat being applied to it, and in ſuch and ſuch circumſtances is capable to exhibit ſuch and ſuch ſubſtances of various

(a) Vid. Hippocrat. de nat. hum. 1.
(b) Vid. Galen. de decr. Hippocr. &c. viii. 7.

forms

forms and natures, tho' these never could exist in a living animal. Indeed there is plainly a great deal of water in our blood. There is likewise sulphur too, or the inflammable principle. The great quantity of oil wherewith all our aliments abound, furnish it sufficiently, and the fat existing in all animals, shews plenty of it in the blood, from which it is secreted. In some circumstances we can discover the oily particles circulating in the mass of blood (a). Innumerable considerations, even the taste itself, convince us of salt in the blood; and there is no room to doubt of earthy particles likewise existing therein. And the air-pump (b) as well as the fire (c), and other operations (d) shew there is air in the blood. But all these elements, as they are called, can neither exist in the blood, nor make up its composition in the sense which the chemists used to understand them. The aerial particles never exert their elastic force in a healthy state (e), and the fetid, volatile and fixed oils and the alcaline salts are entirely the effects of a process which can never exist in the animal body (f), and of a degree of heat which no living creature is able to bear (g).

IV. *The Cartesian hypothesis of the particles of the blood, &c.*

6. Des Cartes and his disciples introduced the particles of his elements into the animal machine. Spheres, cubes, prisms, &c. circulated in the blood, passing through various channels and orifices fitted to them.

7. But all the vessels of an animal affect a round figure (h), the necessity of which is fully made out by

(a) Malpigh. de oment. p. 42. Vit. posthnm. p. 92.
(b) Boyle in Phil. Trans. 63. abr. ii. p. 228, &c.
(c) Hales Veg. Stat. vi. exp. 49. p. 166.
(d) Papin. in Phil. Trans. 121. abr. ii. p. 247.
(e) Boerh. chem. i. p. 525.
(f) Helmont. oper. p. 91, 6, 7. Boerh. Chem. ii. Process 119.
(g) Boerh. ibid.
(h) Fabric. ab Aquapend. de form. fæt. ii. 2. p. 81. Gliſſon. de ventric. &c. xxiii. 21.

Pitcairn (a). We can perceive no variouſly figured corpuſcles in the blood. All we can diſcern, with the beſt microſcopes, are ſpherical particles ſwimming in a pellucid liquor (b), and this leads us to a juſter and more intelligible analyſis of the blood.

V. *The blood made up of globules of different orders or magnitudes.*

8. By numberleſs obſervations, Leeuwenhoeck has ſhewn the largeſt particles of the blood to be thoſe which tinge it of a red colour, and which therefore chiefly make up the craſſamentum of extravaſated cruor. They are of a certain determined magnitude (c) the ſame in different parts of the ſame animal, and even in different animals, however differing in bulk; of the ſame ſize in an ox as in a ſheep (d). And theſe plano-oval particles in the blood of fowls and fiſhes, which reſemble thoſe globules of terreſtrial animals, are the ſame in the greateſt whales as in an eel; the ſame in an eagle as in a ſparrow. Theſe we call the great red globules of the blood, or the globules of the firſt order.

9. Leeuwenhoeck diſcovered the compoſition of theſe globules, which he found (e) made up of ſix ſmaller ſpheres cluſtered together in a regular way, and that ſo nicely, that in a perfect globe the compoſition is imperceptible: But ſometimes he ſaw a red globule looſening and breaking into theſe compounding ſpherules, and ſometimes he perceived theſe running together, and beginning the compoſition of a new red globule. Theſe ſmaller ſpherules we call globules of the ſecond order.

(a) Pitcairn. Diſſ. de circ. ſang. per Vaſa, &c. §. 15.
(b) Malpigh. Vit. poſth. p. 92. Phil. Tranſ. 102. p. 23.
(c) Arcan. nat. det. epiſt. 60. p. 78. Tabor. Exerc. Med. i. 1. §. 2. p. 58.
(d) Leeuwenhoeck, ibid. & epiſt. 128. p. 220.
(e) Ibid. Epiſt. 56. p. 8. Epiſt. 57. p. 36. Epiſt. 128. p. 221, 222. Anat. & contempl. contin. p. 119, 120, 121.

10. This

10. This curious and accurate obſerver ſaw (a) in the chyle and blood a great many particles, ſix times leſs than thoſe of the ſecond order, and thirty-ſix times leſs than the great red globules. The globules of the ſecond order are then to be looked on as compounded of theſe ſmaller particles, which therefore are juſtly to be reckoned as another claſs, or globules of a third order.

11. But moreover, though the ſmaller globules are perfectly tranſparent, and conſequently not diſtinguiſhable one from another, we are certain from ſame Mr. Leeuwenhoeck's obſervations, that there are innumerable veſſels of ſuch a ſmallneſs that none of theſe hitherto mentioned globules ccan paſs; ſo that it is neceſſary to ſuppoſe inferior claſſes of globules of the fourth, fifth, ſixth, &c. orders. Whence by analogy we are to conceive globules of the third order made up of ſix globules of the fourth, and theſe again made up of ſix of the fifth order, and ſo on through ſeveral degrees, the number whereof we are not to take upon us to determine. Leeuwenhoeck (b) ſaw veſſels the wideneſs of which was leſs than the eighth part of the diameter of a red globule; ſo that the particles paſſing through them ſhould be upwards of five hundred times leſs than ſuch globules, and conſequently ſmaller than thoſe of the fourth order. Upon a careful examination (c) he could perceive ſtill ſmaller veſſels narrower than the tenth part of the diameter of a red globule, and conſequently not capable of tranſmitting ſpherules greater than if a red globule were broken down into a thouſand parts. Theſe ſhould almoſt coincide with globules of the fifth order.

12. What a beautiful harmony and regularity do we here perceive in the conſtruction of the maſs of blood! The globules of the firſt order are made up of ſix

(a) Arcan. nat. det. ep. 56. p. 12. Anat. & Cont. par. i. p. 30, 34, 35. Contin. p. 119.
(b) Anat. & Contempl. par. i. p. 31.
(c) Ibid. p. 32.

globules of the ſecond, theſe of ſix of the third, theſe of ſix of the fourth, and ſo on. And accordingly we find that the globules of the higher orders may be broken down into their compounding particles: In ſome caſes that the blood may be turned into ſerum was obſerved by Ariſtotle (a) and Harvey (b). But Boerhaave (c) has moſt diſtinctly of all obſerved how apt the globules of the higher orders are to loſe their contexture and, be broken down into the ſmaller compounding particles, when they are left to themſelves, and without the aſſiſtance of the circulation.

13. It ſeems well worth obſerving, that juſt ſix ſmaller ſpherules ſhould make up a larger globe, if you were to chuſe the moſt convenient and firmeſt way of conſtructing it. In a regular coaleſcence of ſix every ſpherule is in contact with other four, juſt in four equidiſtant points. In fig. 1. and 2. of plate III. we have the ſix ſmaller ſpherules but juſt touching one another before they run together. In fig. 1. we have a view of five of them, A, B, C, D, E, the ſixth F being out of ſight; but turning them a little as in fig. 2. we ſee diſtinctly all the ſix compounding ſperules, three of them lying before and as many behind. In fig. 3. and 4. we ſee the ſame ſpherules adjuſted to one another, and compacted into one greater globe; wherein I have expreſſed the lines of contact, by which we conceive they are run together, and where they would looſen if they were to be diſſolved and broke aſunder.

14. From this conſtruction of the blood, Bohn's (d) aerial bubble in the red globules appears unneceſſary, although Bernouilli (e) and Keil (f), upon finding a globule on its arrival at a paſſage too ſmall for it to be flattened and compreſſed till it had paſſed into a wider

(a) Hiſt. animal. iii. 19.
(b) De gen. animal. l. i. p. 160.
(c) Aphor. § 94, 95. Chem. ii. proc. 127.
(d) Circ. Anat. xiii. p. 199.
(e) Diſſ. de mot. muſc. § 5.
(f) Tentam. v. p. 135.

canal,

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Fig. 1.

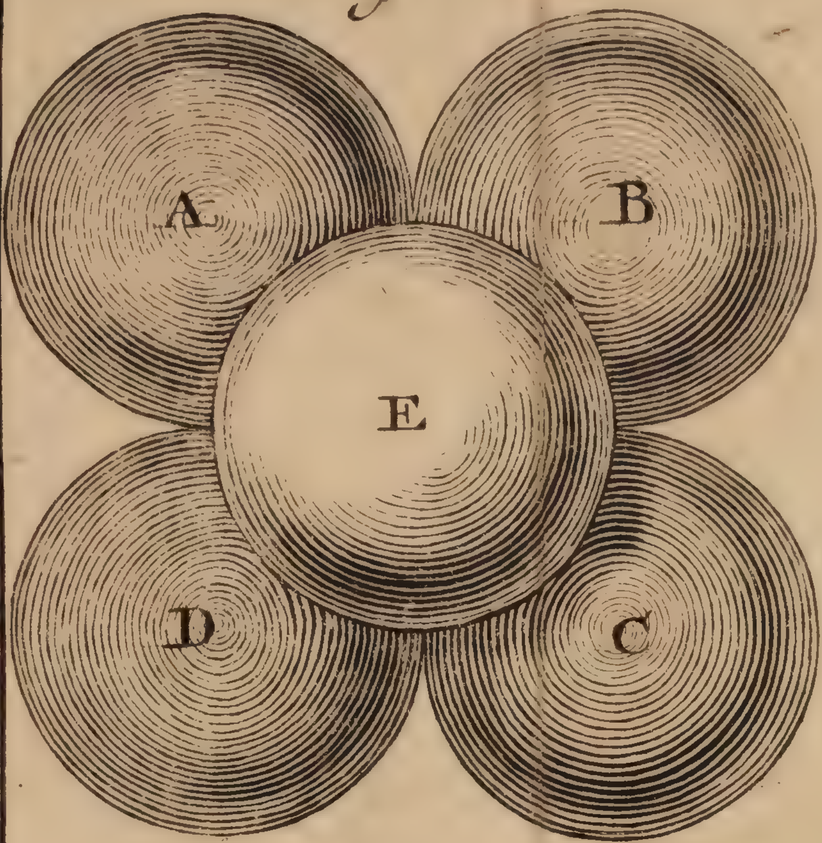


Fig. 3.

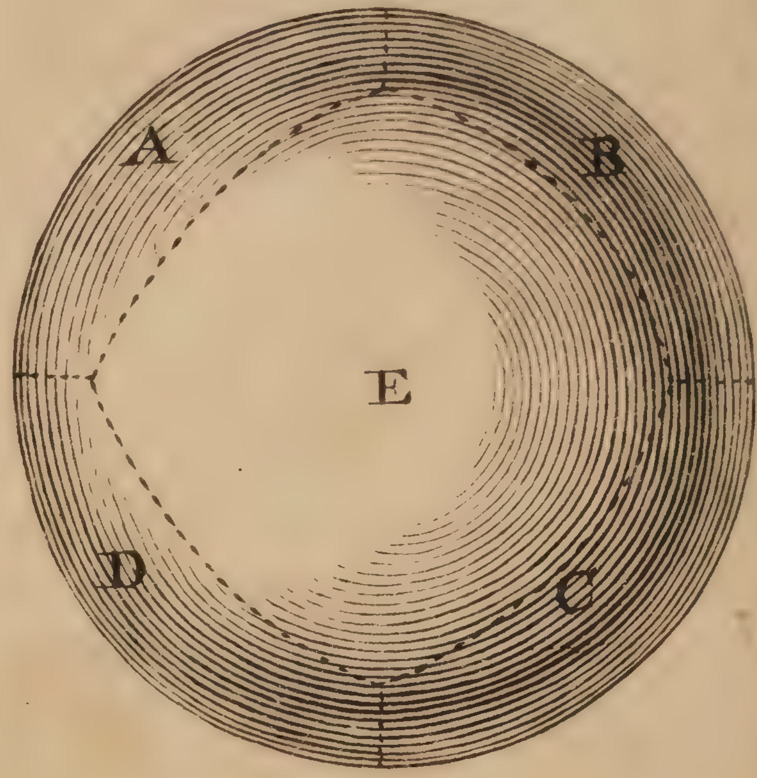


Fig. 2.

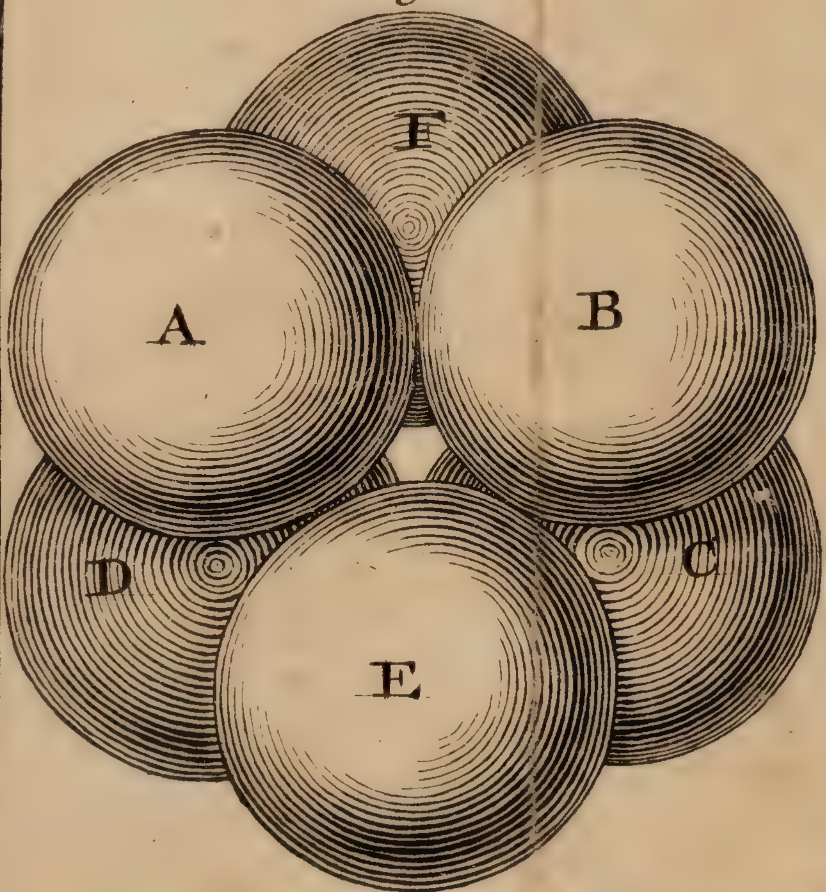


Fig. 4.

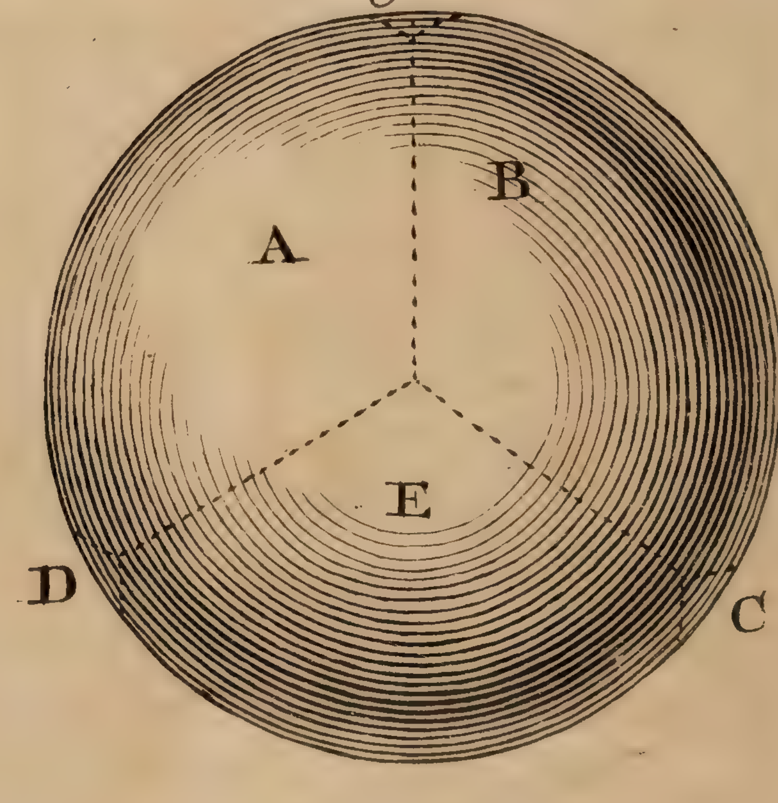
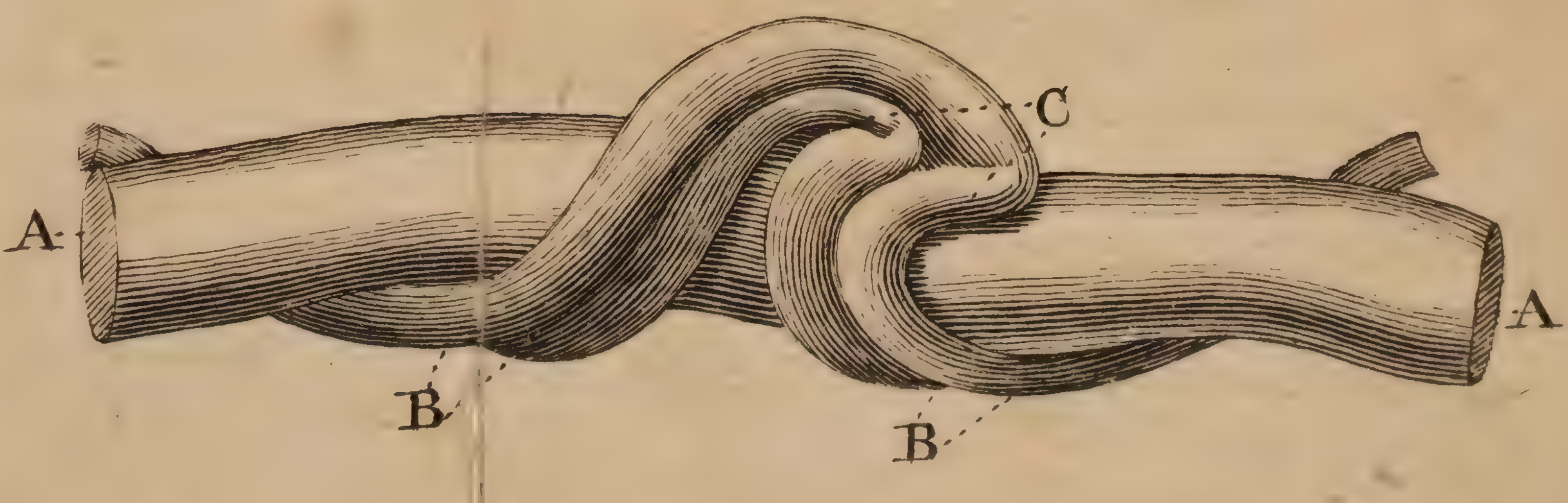


Fig. 5.



canal, where it reaſſumed its former round figure, concluded that this phænomenon was owing to an included elaſtic fluid; yet the common property of the particles of all fluids to aſſume on contact a ſpherical figure accounts for it in a more obvious as well as ſimple manner.

15. Not only the compounding particles of each globule are endued with this property, but likewiſe the globules themſelves have a ſtrong mutual attraction. When extravaſated blood is left to itſelf, the red globules run forcibly together, and ſqueeze out the intervening ſerum in ſome animals with a greater, in others with a leſs force. This force in the blood of deers is ſo weak that it ſcarcely coagulates into a firm craſſamentum (a). On the contrary, in ſome great and ſtrong beaſts, it becomes a tough and almoſt indiſſoluble maſs: So that the blood of bulls was frequently drunk by the ancients as a moſt effectual poiſon (b). Nay even the pellucid watery ſerum which conſiſts of globules of inferior orders, is very ready to loſe its fluidity. In a certain degree of heat, before much of it is exhaled, it becomes a firm and ſolid ſubſtance (c).

16. The fibres, which Malpighi ſtrenuouſly aſſerted were in the blood, are not to be found in it in a natural ſtate (d). If they were in the veſſels of animals, they muſt diſturb the circulation. And their exiſtence ſeems to be entirely owing to a ſubſequent preparation of extravaſated blood, whoſe viſcid parts by the heat of warm water, and conquaſſation, or ſome other ſimilar artifice, run together in ſuch new forms.

(a) Ariſtot. hiſt. animal. iii. 19. part. animal. ii. 4. Meteorolog. iv. 7. Plin. hiſt. nat. xi. 38.

(b) Herodot hiſt. iii. 15. Plin. hiſt. nat. xi. 33. xx. 9. xxiii. 7. Plutarch. in vita Themiſtocl.

(c) Galzadius apud Barbat. Diſſ. de ſang. &c. p. 10. Boyle of fluids. &c. abr. i. p. 329.

(d) De polyp. cord. p. 125. Vit. poſthum. p. 45.

VI. *Of the temperaments denominated from the conſtituent parts of the blood.*

17. All animals (I mean ſuch as we are chiefly concerned with) have globules of all the ſeveral orders ſcattered through their blood, but in no fixed proportion, which may likewiſe be affirmed of the conſtituent parts of the blood, when they are conſidered as giving riſe to the compounding humours of the ancients, and to the chemical elements. From the conſideration of which variety, it will be of uſe to take a view of the various temperaments of the human body, that we may the better underſtand the ſyſtems of the ancients, and alſo have ſome idea of a middle conſtitution, to which all the calculations relating to the properties of the blood are to be referred.

18. If the blood be plentiful and abound with red globules, ſuch a ſtate will conſtitute the temperamentum ſanguineum; the ſymptoms whereof are eaſily explained from theſe circumſtances.

19. When the red globules were ſcarce in the blood, and it was found thin and watery, this was called a phlegmatic temperament.

20. If the blood had a great many thick, tough, and leſs moveable particles, theſe the ancients looked on as the chief ingredients in the atra bilis; and ſuch a conſtitution was with them the temperamentum melancholicum; in which ſtate Boerhaave (o) thinks that the earthy and ſome of the more viſcid oily particles chiefly abound.

21. Our aliments are generally of an aceſcent kind; but by the action of our bodies on them they are ſoon reduced to a neutral ſtate, the force of the circulation bringing the particles of the blood always farther and farther from their former acidity, animalizes them more and more, renders them volatile and perſpi-

(o) Inſt. Med. § 228. Aphor. §. 1092, 1097.

rable

rable (a); and at length, if there be no new ſupplies or obſtacles to hinder it, diſpoſes them to an alcaleſcent ſtate (b), the breath ſtinks (c) and the blood turns putrid (d). Now the bile is found (e) to have undergone a long courſe before it is ſecreted from the reſt of the blood, and to be one of the moſt perfect animal liquors, and the furtheſt removed from any aceſcent quality; and in plenty and perfection in thoſe who have a ſtrong circulation, and all their vital operations carried on with vigour (f). Such a conſtitution going to too great a height the ancients called a choleric or bilious hot temperament (g).

22. The direct contrary of which, importing an irregular and weak circulation, and not ſufficient to overcome, and alter the diſpoſition of our aliments, ſeems to coincide in a great meaſure with the cachexia of the ancients (h); which might be looked on as a ſort of temperament, and a deviation from the natural and regular conſtitution; and not ſo properly to be a particular diſeaſe, as a ſtate of the body giving riſe to a great many diſeaſes eaſily flowing from ſuch a ſtate. And this frequently falls in with the phlegmatic temperament; as on the other hand the ſanguineous and choleric are often blended together. Other general deviations of the body from a middle ſtate might be called temperamentum oleoſum, ſalinum, calidum, frigidum, &c.

23. The blood which is as it were in a middle ſtate between all theſe, which has neither too much cruor nor too much ſerum, nor too much earth, ſalt, or oil,

(a) Helmont. p. 91, 4. p. 148, 31. p. 149, 34. p. 150, &c. 39.
(b) Vid. Boerh. Aphor. §. 80, 109. Chem. proc. 88. p. 293.
(c) Proc. 95. p. 313.
(d) Proc. 100. p. 323.
(e) Vid. Boerh. Inſt. Med. § 99. p. 350.
(f) Hoffman. med. rat. i. p. 182.
(g) Ariſtot. Prob. xiii. 7. Patron. Satir. §. 128. Martial. Epigr. iv. 4. Aul. Gell. ii. 23.
(h) Vid. Aret. de Chronic. cauſ. &c. i. 16. Cæl. Aurelian. Chronic. iii. 6,

nor

nor the product of too weak nor too ſtrong a circulation, we call the blood of a regular conſtitution, or middle temperament, to which the reſt are to be referred, and which people are underſtood to mean when they ſpeak of the blood in general and in a ſound ſtate. All are very liable to a deviation from this middle ſtate. The blood of young ones is generally thin and watery, that of old people thick and black, but the middle-aged folks are readieſt to have a biliary and ſanguineous diſpoſition.

VII. *The proportions of the chemical elements.*

24. The ancients did not pretend to determine the proportions which their four elements bear to one another. But the chymiſts have had a better opportunity to make a tolerable eſtimate of the quantity of their principles of the human blood, which however is not to be expected perfectly exact, or nearly alike in all trials. However by way of example, we ſhall take an experiment of the accurate Mr. Boyle (a), who by diſtilling ten ounces and ſeventy three grains of human blood at a ſlow fire, found it to yield the following ſubſtances.

	Grains.
Phlegm riſing by a gentle heat differing little (b) from common water, with two or three grains of volatile ſalt diſſolved in it	3527
Volatile parts loſt in diſtillation, of the ſame nature with the collected phlegm - -	266
And ſo theſe two phlegms put together -	3793
The dry ſubſtance or reſiduum of this diſtillation . - - - - -	1080

This reſiduum diſtilled a ſecond time at a ſtronger fire gave

Fœtid oil - - - - -	168

(a) Hiſt. hum. blood, p. 231. abr. iii. p. 459.
(b) Vid. Vieuſſens in Phil. Tranſ. 241. abr. iii. p. 243.

Dry

	Grains
Dry volatile ſalt purified from its adhering ſpirit - - - - - -	65
Volatile ſaline ſpirit collected -	48
Particles loſt, partly this ſaline ſpirit, and partly air, which in this period of the diſtillation begins to riſe (a) - -	427
The air thrown off by ſuch a diſtillation, according to Hales's experiment (b), ſhould be - - -	171
And ſo the ſpirit loſt was - - -	256
Which added to forty eight grains, the former volatile ſaline ſpirit, makes -	304
Caput mortuum - - - -	372

The gr. 168 of fœtid oil analyſed in Vieuſſens's way (c) ſhould have given

Saline ſpirit - - -	99
Yellow thick oil - - -	60
Fixed ſalt - - - - -	3
Fixed earth - - - -	6

The gr. 304, and gr. 99 of ſaline ſpirit, making in all gr. 403, analyſed according to a like method (d), ſhould have given,

Water — — —	278
Volatile ſalt — —	125

Caput mortuum gr. 372. calcined gave

Fixed ſalt — — —	18
Moſt fixed earth — —	26
Particles evaporated in the open fire —	328

The proportions of whoſe ingredients cannot well be determined; but from ſome ſort of analogy we gueſs them to be about theſe following, neglecting the air, which was diſſipated at this time.

(a) Hales Veg. Stat. Exp. 49. p. 167. Exp. 51. p. 168.
(b) Ibid. Exper. 49. p. 166.
(c) Phil. Tranſ. 241. Abr. iii. p. 245.
(d) Boyle hiſt. hum. bl. p. 112, 125, 126, 242. Abr. iii. p. 473, 475.

Grains

				Grains
Oil	——	——	——	273
Salt	——	——	——	22
Earth	——	——	——	33

From all which, the blood being unity, and consisting of gr. 4873, a chemist would reckon these elements in the following proportions:

Water	- - - -	gr. 4086	- - - -	$\frac{5}{6}$
Oil	- - - -	333	- - - -	$\frac{1}{15}$
Salt	- - - -	190	- - - -	$\frac{1}{25}$
Earth	- - - -	65	- - - -	$\frac{1}{75}$
Air	- - - -	171	- - - -	$\frac{1}{28}$

25. The watery or phlegmatic part of the blood abounds above the other principles. It takes up $\frac{5}{6}$ parts of the whole mass, and other experiments (a) shew it still in a greater quantity: And it exceeds the oil above a dozen times; and the oil is in greater plenty than any of the rest of the ingredients. However some of these elements may still be resolved into one another, or into more simple parts, so as to increase or diminish the above proportions.

VIII. *The proportional quantities of the globules of different orders.*

26. In cold and sufficiently coagulated blood, the tough crassamentum and its surrounding fluid, serum, are (b) ordinarily found to be pretty nearly equal to one another. And Jurin supposes (c) the interstices of the red globules of the crassamentum to be nearly equal to the globules themselves, so as to render them $\frac{1}{4}$ of the whole mass.

27. The interstices would indeed take up almost such a space if the globules were all regularly disposed so as to lye perpendicular over one another in a square

(a) Boerh. Chem. ii. proc. 119.
(b) Vid. Boyle hist. hum. bl. p. 252. Abr. iii. p. 460.
(c) Phil. Trans. 361. Abr. v. 1. p. 326.

form.

form. But it is plain they could not well ſubſiſt in that ſtate: Their natural lubricity would be readier to diſpoſe them in a more compact figure, as perhaps in a quincuncial order or the like. And in ſuch a caſe by a calculation differing conſiderably from Tabor's (a) I find that the interſperſed ſpaces put all together would take up but $\frac{1}{4}$ of the craſſamentum, and the blood-globules $\frac{3}{4}$ thereof: So that on this ſuppoſition theſe would be $\frac{3}{8}$ of the whole maſs. But neither is it likely they ſhould be ſo very regularly and compactly diſpoſed; and therefore, making ſome allowances for irregularities, it may ſeem reaſonable rather to reckon that theſe globules ſhould take up only about $\frac{2}{3}$ of the craſſamentum, and conſequently $\frac{2}{6}$ or $\frac{1}{3}$ of the maſs and the ſerous part to take up the other $\frac{2}{3}$ thereof. In this caſe the red globules being ſuppoſed to be ſcattered uniformly through the blood; their mean diſtance from one another by a geometrical calculation comes out about $\frac{1}{4}$ of their diameters: And this falls in nearly with Tabor's (b) obſervation, which however could not well be made with ſufficient accuracy.

28. Now as the blood is a compound of globules of all the ſeveral orders, ſo is the ſerum a compound of the globules of the ſecond order, and of all the inferior orders. And as the red globules, or thoſe of the firſt order, take up $\frac{1}{3}$ of the whole maſs, ſo from analogy thoſe of the ſecond order ſhould take up a third part of the ſerum, the other two thirds are made up of globules of the third and ſubſequent orders, and ſo on in this progreſſion.

The entire maſs of blood — —	1
Globules of the firſt order — —	$\frac{1}{3}$
Serum — — — —	$\frac{2}{3}$
Globules of the ſecond order — —	$\frac{2}{9}$
The reſt of the ſerum conſiſting of globules of the third and inferior orders —	$\frac{4}{9}$
Globules of the third order — —	$\frac{4}{27}$

(a) Exerc. med. i. 1. §. 5. p. 61. (b) Ibid. p. 60.

The

The remainder of the serum being globules of the fourth and inferior orders —	$\frac{8}{27}$
Globules of the fourth order ——— q. p.	$\frac{1}{10}$
The remainder, being globules of the fifth and inferior orders —— ——	$\frac{1}{5}$
Globules of the fifth order —— ——	$\frac{1}{15}$
The remainder, being globules of the sixth and inferior orders —— ——	$\frac{2}{15}$
Aggregate of the seventh and inferior orders —	$\frac{4}{45}$
Globules of the seventh order —— q. p.	$\frac{1}{34}$
Aggregate of the eighth and inferior orders ——	$\frac{1}{17}$
Globules of the eighth order ——	$\frac{1}{51}$
Aggregate of the ninth and inferior orders q. p.	$\frac{1}{25}$
Globules of the ninth order ——	$\frac{1}{75}$
Aggregate of the tenth and inferior orders q. p.	$\frac{1}{38}$
Globules of the tenth order ——	$\frac{1}{114}$
Aggregate of the globules of the eleventh and inferior orders if there be such —	$\frac{1}{57}$

IX. *The denſity of the maſs of blood.*

29. Having thus conſidered the ſeveral quantities of the compounding particles of the blood, it's ſpecific gravity comes next to be conſidered. Dr. Jurin (a) found the denſity of the blood to be 1054. As far as I can judge by comparing it with rani-water, and taking great care that there were no bubbles of air in the blood when I made my experiments, I found their denſities as 1000 to 1056 or 1057, or as 18 to 19. q. p. Perhaps the water I uſed being lighter than the water made uſe of in Dr. Jurin's experiments might occaſion this ſmall variation.

30. But we muſt obſerve a very remarkable difference in the blood according to its different ſtates; whether as circulating in the veſſels of the animal, or as it is expoſed to the cold air, in which condition we commonly examine it; from whence after ſufficient

(a) Phil. Tranſ. 361. Abr. v. i. p. 324.

allowances, we muſt inveſtigate its real and natural denſity while in a live ſtate. All bodies are condenſed by cold and expanded again by heat; therefore cold blood is ſpecifically heavier than the warm fluids circulating in the veſſels of a living animal, but by how great an odds is not eaſy to be determined.

31. Some eſtimate the heat and denſity of the living blood upon its firſt emiſſion: In which caſe, in its exit, and while you collect a ſufficient quantity to make your experiment, it has loſt conſiderably both of its heat and natural expanſion.

32. One would be ready to judge of the expanſion of blood from what we find it in water. Now Dr. Halley (a) found water reaſonably cold but not freezing, to be expanded $\frac{1}{26}$ part by boiling; that is, as I judge, from 12 degrees to $34\frac{1}{2}$ in a thermometer conſtructed in Sir Iſaac Newton's way: The ſame difference was aſſigned by Leeuwenhoeck (b). Whence water in a temperate degree of heat, about four degrees, ſhould be expanded $\frac{1}{93}$ part, by the heat of 12 degrees, $\frac{8}{10}$; to which I find the thermometer riſes by the blood of thoſe living animals whoſe vital operations come neareſt to the human, not 14 degrees and $\frac{3}{11}$, as Sir Iſaac Newton (c) and Mr. Hales (d) by ſome miſtake reckoned it. But by repeating ſome experiments of this nature, I could not perceive the expanſion to be near ſo great, as is deduced from Halley's and Leeuwenhoeck's experiments. Perhaps in their boiling water there were ſome air-bubbles.

33. This makes me ſuſpect likewiſe ſome miſtake in Tabor's experiment (e), by which he determined the cold ſerum, when brought to the temperature of living blood to be expanded $\frac{1}{62}$ part.

34. Weighing carefully a certain quantity of human blood, drawn from a man in health in the morning,

(a) Phil. Tranſ. 197. Abr. ii. p. 34.
(b) Arcan. Nat. det. ep. 68. p. 214.
(c) Phil. Tranſ. 270. Abr. iv. 2. p. 2.
(d) Veg. Stat. i. Exp. 20. p. 59.
(e) Exerc. med. i. 1. §. 7. p. 63.

and

and flowing directly into a phial which was immerſed in water, which raiſed the liquor in the thermometer to 12, 8 degres; and then letting it cool in a temperate air, about four degrees, I found it condenſed $\frac{1}{135}$ part. So that the denſity of the blood in living animals is to its denſity when reduced to the coldneſs of temperate air as 134 to 135 or $992\frac{1}{2}$ to 1000. Water and urine tried the ſame way ſuffered very near the ſame degrees of rarefaction and condenſation. Hog's blood ſeemed to undergo ſome greater change, but no greater than what might flow from a greater quantity of oily particles in its compoſition.

35. There is one conſideration too often neglected The veſſels in which our areometrical experiments are performed, ſuffer likewiſe a dilatation by the application of heat, though in a much leſs degree than the contained fluids. It is the exceſs of the expanſion of theſe above the dilatation of the containing veſſels that is commonly recorded in obſervations of this kind: But they muſt both be taken in to determine the real changes the fluids undergo in the different ſtates of heat and cold. Glaſs may be lengthened by the heat of the human body about $\frac{1}{1200}$ part of its dimenſions; ſo that a thin glaſs phial ſhall be enlarged in its contents about $\frac{1}{400}$ part. Whence the real denſity of cold blood to its denſity when circulating in a live animal comes out in a compound ratio of 135 to 134, and 400 to 399. And ſo we may conclude the real denſities of water and blood to be in theſe proportions,

Water in a temperate degree of heat —— 1000
Freezing —— —— 1003
Of the heat of the blood in the human body 990
Blood of the heat of temperate air —— 1056
In it's natural living ſtate —— $1045\frac{4}{9}$

36. Hence we ſhall be able to determine the weight of a given bulk of blood, which is not ſo accurately done hitherto as it deſerves: This being of ſingular uſe in our enquiries concerning the velocities, moments, &c. of the circulating liquors, and the forces of the heart and other organs in the animal machine.

From

From accurate experiments we conclude a cubic inch of rain-water to weigh $253\frac{1}{3}$ grains. Whence a cubic inch of warm blood will be equal to $264\frac{3}{4}$ grains, and an ounce of blood will be 1,813 inches. An averdupois ounce is found to weigh $437\frac{1}{2}$ grains, and therefore is in water equal to 1,727 inches; and 1,6526 inches of warm blood.

Seeing a cube is to its inscribed sphere as 1 to 0, 5236, a globe of water of an inch diameter must weigh $132\frac{2}{3}$ grains and a sphere of blood of the same size, $138\frac{5}{8}$ grains.

X. *The densities of the globules of different orders.*

37. We formerly found *(a)* the density of cold blood to be 1056. Jurin concludes (*b*) the specific weight of serum to be only 1030; Tabor's observation (*c*) makes it 1031; and I found it nearly the same. So that when compared to limpid rain-water, it may safely enough be reckoned 1032, which is then $\frac{1}{43}$ part lighter than blood. The serum therefore when reduced to the heat of live blood should be $1032 \times \frac{99}{100} = 1021\frac{2}{3}$.

38. Since the crassamentum is about one half of the whole mass *(d)*, it, when taken by itself, must as far exceed in density the common mass as this does the serum; and consequently should be 1080, to which computation experience comes very near. For at a medium of several trials Dr. Jurin found it *(e)* 1084. The very different consistence of the crassamentum of the blood of different persons will not allow us to expect a great uniformity in such experiments; however I found it generally something above 1080. Perhaps the handling of it might have squeezed out several of the thinner and lighter particles of the interspersed serum; so that we found it specifically heavier than naturally it should have been.

(a) §. 29. (b) Phil. Transf. 361. Abr. v. 1. p. 323.
(c) Exerc. med. i. 1. §. 7. (d) §. 26. (e) Phil. Transf. ibid. p. 327.

39. About two thirds of this craſſamentum are taken up by red globules, the other third by ſerum (a), from whence the denſity of theſe globules is found 1104. It comes out the ſame from our former determinations of the denſity of ſerum as 1032 (b), and that of blood as 1056 (c), and the red globules being $\frac{1}{3}$ of the entire maſs of blood (d). It is true Jurin (e) reckoned the ſpecific gravity of the blood globules to be 1126, but he ſuppoſed the quantity of theſe globules to be only $\frac{1}{4}$ of the whole maſs; whereas the former reaſons obliged us to reckon them a third thereof. So then the true denſity of a red globule circulating in the blood of a living man is $1104 \times \frac{99}{100} = 1093$.

40. And thus we have found that the red globules are the heavieſt parts of the blood, and that they as well as the groſſer ſerum, by being broken down into ſmaller globules, loſe ſomething of their ſpecific weight. So that it is very obvious to infer, that as the globules of the firſt order are the denſeſt as well as the biggeſt particles of the blood, ſo theſe of the ſecond order come neareſt to them in each of theſe properties. Theſe of the third order as they are ſmaller, ſo are they ſpecifically lighter than the preceding, but bigger and heavier than the globules of the fourth and ſubſequent orders, and ſo on: So that we are to conceive the maſs of blood as made up of a congeries of ſpherules differing in denſity as well as magnitude.

41. We have been able to determine the real denſity of the red globules; but how ſhall we arrive at any knowledge of the globules of the inferior orders? We have the denſity of the maſs of blood 1045 (f), of the red globules 1093, and of the ſerum 1022; and from theſe three data we ſhall neceſſarily have a very regular and conſiſtent ſeries, if we reckon the differences of denſity between any order and its ſubſe-

(a) §. 27. (b) §. 37. (c) §. 29. (d) §. 27.
(e) Phil. Tranſ. ibid. p. 326, 327. (f) §. 35.

2 quent

quent one to be a third part greater than the difference between that subsequent one and what immediately succeeds it. Thus if α, β, γ δ, &c. be the densities of the orders A, B, C, D, &c. Then $\alpha-\beta\times\frac{2}{3}$ will be equal to $\beta-\gamma$, and $\beta-\gamma\times\frac{2}{3}$ equal to $\gamma-\delta$, and so on; these differences of densities decreasing in a geometrical proportion; so that at length the very minute globules of the inferior orders come all to be nearly of the same specific weight; by this rule the specific weights of the several orders of globules, are in the following proportions,

The mass of warm blood or the globules of the first and all the subsequent orders,	1054
Globules of the first order, ——	1093
The serum, or globules of the second, and all the subsequent orders, ——	1022
Globules of the second order, ——	1053
Globules of the third and subsequent orders,	1006
Globules of the third order, ——	1027
Globules of the fourth and subsequent orders,	995
Globules of the fourth order, ——	1009
Globules of the fifth and subsequent orders, -	988
Globules of the fifth order, ——	998
Globules of the sixth and subsequent orders,	984
Globules of the sixth order ——	990
Globules of the seventh and subsequent orders,	980
Globules of the seventh order, ——	985
Globules of the eighth and subsequent orders,	978
Globules of the eighth order, ——	981
Globules of the ninth and subsequent orders,	977
Globules of the ninth order, ——	979
Globules of the tenth, and subsequent orders,	976
Globules of the tenth order, ——	977

42. We are not to wonder that the globules of the seventh, and all the lower orders, are specifically lighter than water of the same degree of heat; they take up only the eleventh part of the mass of blood *(a)*. And the liquors of our bodies are all stored with light

(*a*) §. 28.

oily particles, and that in greater abundance than either with salt or earth (a); which therefore are capable to render the parts of the blood lighter than water, were it not that the vis vitæ, constantly operating in the animal machine, the sanguineous elements are wrought up and compacted together in such a way as to render all the larger sized globules much denser, and the whole mass considerably heavier than water.

XI. *The diameters, magnitudes, weights, &c. of the globules of the blood.*

43. From the construction of the blood formerly described (b), it is plain that the quantity of matter of the globules of any order is six times the quantity of matter of the globules of the next succeeding order; and the same ratio would hold of their bulk or size, if they were all of the same density. But by their variety in this respect, their bulks do not exactly follow this proportion; for these are directly as their quantities of matter, and inversely as their respective specifick weights. And their diameters are as the cube roots of these magnitudes. Thus the magnitude of a red globule, is to that of a globule of the second order in a compound ratio of 1 to $\frac{1}{6}$ directly, and 1093 to 1053 reciprocally; that is, as 1 to $\frac{1}{5,78}$. And their diameters as 1 to $\frac{1}{1,795}$, and so on of all the rest as in the following table.

(a) §. 24. (b) §. 9, &c.

The

The orders of globules.	Quantities of matter of the globules.	Magnitudes of the globules.	Diameters of the globules.
1	1	1	1
2	$\frac{1}{6}$	$\frac{1}{5,78}$	$\frac{1}{1,795}$
3	$\frac{1}{36}$	$\frac{1}{33,83}$	$\frac{1}{3,234}$
4	$\frac{1}{216}$	$\frac{1}{199,4}$	$\frac{1}{5,842}$
5	$\frac{1}{1296}$	$\frac{1}{1182}$	$\frac{1}{10,57}$
6	$\frac{1}{7776}$	$\frac{1}{7043}$	$\frac{1}{19,17}$
7	$\frac{1}{46656}$	$\frac{1}{42033}$	$\frac{1}{34,77}$
8	$\frac{1}{279936}$	$\frac{1}{251249}$	$\frac{1}{63,1}$
9	$\frac{1}{1679616}$	$\frac{1}{1504400}$	$\frac{1}{113}$
10	$\frac{1}{10077696}$	$\frac{1}{9000000}$	$\frac{1}{208}$

44. Thefe are the proportions the feveral orders of globules bear to one another: But it will be required to determine, if poffible, their real dimenfions compared to fome known magnitude.

45. Mr. Leeuwenhoeck reckoned (a) the diameter of a red globule of the firft order to be the $\frac{1}{100}$ part of the diameter of a large grain of fand, and confequently $\frac{1}{1000000}$ part of its bulk. But this is fomewhat too vague; he not having determined the real diameter of fuch a grain of fand: however, we may prefume he meant by it a grain of fand of the larger

(a) Anat. & contempl. p. 35, & paffim alibi.

ſort, the thickneſs whereof he judged to be about $\frac{1}{30}$ part of an inch (a); and conſequently an inch ſhould be 3000 times broader than the diameter of a red globule. Tabor (b) computed it $\frac{1}{3600}$ part of an inch. But his method is not capable of the deſired exactneſs. Jurin and Leeuwenhoeck both found the apparent diameter of a red globule to be $\frac{1}{1940}$ part of an inch (c). If this globule be ſuppoſed circulating in our body, and heated to the ordinary degree of living blood, then its diameter will be enlarged; to wit, in the ratio of $\sqrt[3]{100}$ to $\sqrt[3]{99}$ (d), which is nearly in the ratio of 300 to 299. Whence the true diameter of a red globule in its natural ſtate comes out $\frac{1}{1940} \times \frac{300}{299}$, or $\frac{1}{1933,5}$ part of an inch. In the ſame manner the diameter of a globule of the ſecond order is equal to $\frac{1}{1933,5} \times \frac{1}{1,795}$, or $\frac{1}{3470,6}$ part of an inch; And ſo on thro' the other orders, as in the following table.

Orders of globules.	Diameters of the globules in parts of an inch.	Orders of globules.	Diameters of the globules in parts of an inch.
1	$\frac{1}{1933,5}$	6	$\frac{1}{37065}$
2	$\frac{1}{3470,6}$	7	$\frac{1}{67228}$
3	$\frac{1}{6253}$	8	$\frac{1}{122000}$
4	$\frac{1}{11295}$	9	$\frac{1}{218500}$
5	$\frac{1}{20437}$	10	$\frac{1}{402170}$

46. Sir Iſaac Newton (e) has determined the thickneſs of a particle of water reflecting ſcarlet of the ſecond order of colours to be $\frac{14,75}{1000030}$ parts, or $\frac{1}{67797}$

(a) Anat. & contempl. p. 39. (b) Exerc. med. i. 1. §. 3 (c) Phil. Tranſ. 377. p. 341. (d) § 35. (e) Opticks ii. 2. p. 206.

part

part of an inch, which almoſt coincides with $\frac{1}{67228}$ part of an inch, the diameter of the globules of the blood of the ſeventh order.

47. From hence it is eaſy to determine the real magnitudes of the globules of each of theſe orders. The bigneſs of a globule of the firſt order, is to a ſphere of an inch diameter in the triplicate ratio of 1 to $1933\frac{1}{2}$, which is as 1 to 7228240000.

48. A ſphere of water of an inch diameter, weighs $132\frac{2}{3}$ grains; and therefore a ſphere of matter of the ſame denſity with the red globules of blood ſhould weigh gr. $132\frac{2}{5} \times \frac{1093}{1000} =$ gr. 144,986, conſequently a grain ſhould be able to counterpoiſe $\frac{7228240000}{144986}$, or 49854600 that is near fifty millions of ſanguineous globules of the firſt order. What a prodigious minuteneſs does this ſeem to be! And yet theſe are the biggeſt particles which naturally exiſt in the circulating fluids of the human body, and immenſely bigger than the leſſer ſized globules; and all of them are again to be conceived as made up ſtill of minuter particles, and elements of different kinds.

An eſſay on the nutrition of the fœtus in utero, by Mr. JOSEPH GIBSON, *Surgeon at Leith, Member of the Society of Chirurgeon-Apothecaries of Edinburgh, and City Profeſſor of Midwifery.* Vol. I. art. 13.

THE way by which the fœtus is maintained, is ſtill matter of diſpute, although it has been long debated by philoſophers and phyſicians. In order to clear up this intricate ſubject, I ſhall, firſt, range and ſtate the different opinions of authors, together with the grounds and arguments which ſupport them; and by the way hint alſo at thoſe which oppoſe them. Secondly, I ſhall explain that opinion which appears to me to be moſt conſiſtent with truth, and endeavour to confirm it by evident facts, rational conſequences, and natural analogy.

The first opinion is, That the fœtus receives all its nourishment by the mouth. This was an early notion (a), but supported by an imaginary hypothesis, That in the uterus there are little dugs, to which the embryo applies its mouth, and from thence sucks its aliment, and that therefore so soon as it is born, it draws its nourishment in the same manner from the breast. Some of the moderns have added much stronger reasons to prove, that the fœtus receives its nourishment by the mouth. These are reducible either to a denial of any communication of the blood-vessels of the mother and infant, or to an absolute unfitness of the mother's blood for that purpose.

The denial of a communication betwixt the blood-vessels of the mother and infant, depends on this, That there follows no blood upon the division or separation of the umbilic vessels from the cotyledons of brutes. But this is an inference too hastily and inconsequentially drawn, from a true observation: for the brute cotyledons differ from the human placenta, and upon the extraction of the umbilick vessels from them, the sockets in which they were lodged instantly purse up by their proper elasticity, and so prevent the least drop of blood issuing: Whereas the uterine arteries of women having the umbilic veins of their proper fœtus implanted, without any intervening medium, do constantly pour out blood upon the separation of the placenta from the uterus, which is always in proportion to the elasticity of the uterine vessels, or the contraction of the womb.

Mr. Jussieu maintains the nutrition of the fœtus by the mouth, from the consideration of the unfitness of the maternal blood for its support, asserting that there exist in it many fiery and but few alimentary particles; and that its motion being too rapid would rather beat into disorder the weak and tender parts of the embryo, than gradually extend and encrease it. The first two of these arguments are trifling and pre-

(a) Plutarch. de Placitis Philosophorum. lib. 5. cap. 16.

carious;

carious; nor does there appear to be much in the third; however, I ſhall have occaſion in the ſequel of this eſſay to obviate its force.

The ſecond way whereby the fœtus was ſuppoſed to be nouriſhed, was by the umbilic veſſels, and theſe only. The Stoic Philoſophers (a) taught this doctrine, and Hippocrates, Ariſtotle and Galen alſo allowed that the fœtus received part of its nouriſhment this way, and therefore Andreas Laurentius (b), to whom ſoon afterwards Fabricius ab Aquapendente (c) aſſented, is the firſt among the medical tribe who adopted this opinion: But indeed many amongſt the moderns have defended this argument, among whom Dr. Bellinger has treated profeſſedly of it (d). This gentleman takes for granted, the communication betwixt the mother and fœtus by the umbilic veſſels, and then endeavours to prove by negative arguments, that the mouth is not concerned in nouriſhing the fœtus, and the liquor of the amnios is unfit for nouriſhment, and thence infers, that the fœtus muſt receive all its nouriſhment by the umbilical veſſels. I ſhall conſider his arguments as they lie in order, of which this is the firſt and principal one. That ſince monſters have been brought forth perfectly formed, their want of mouths, or, in ſome, of heads, excepted, the fœtus cannot therefore in a natural way be imagined to have its nouriſhment communicated to it by the mouth. This argument depends upon a very uncertain and precarious ſuppoſition, namely, that the want of any part in an otherwiſe well grown monſtrous fœtus, proves it to be uſeleſs in a natural ſtate. Beſides, where monſters have been brought forth, or at leaſt having their mouths ſhut, this defect is often, if not always, found to be ſupplied by ſome other contrivance.

To prove this poſition, I ſhall mention two examples, the firſt of theſe being recited by Dr. Gibſon, in

(a) Plutarch de placit. philos. l. 5. c. 16. (b) Lib. 8. cap. 6. (c) Lib. de format. fœt. cap. 8. (d) De fœt. nutrit.

his

his anatomy of human bodies (a) at ſome length, I muſt refer to the paſſage, and only tranſcribe his comment upon the diſſection. This (ſays he) is a plain confirmation of the fœtus being nouriſhed by the mouth; for the gula being impervious, nature had formed a hole in the wind-pipe, and below in the gullet, for the liquor contained in the amnios to paſs into the ſtomach, which it might eaſily do without prejudice, or any fear of choaking the child in the womb, while it breathed not; but when it was born and came to breath, there could be no longer any paſſage this way, and ſo the infant was neceſſarily famiſhed. And agreeable to this, Vander Wiel (b) aſſures us, that at the Hague he ſaw a monſtrous lamb, who having no mouth, had its nouriſhment, during its ſtay in the womb, conveyed to it by an aperture in the lower part of the neck. But further, when this deviation from nature happens, and is not ſupplied in the manner I have hinted, the ſtomach is found empty, and there are few or no excrements in the guts (c). In fine, as the examples of ſuch monſters are rare, neither extraordinary well vouched, nor often accurately examined, the arguments drawn from thence againſt the nutrition of the fœtus by the mouth, can never be excluſive, and are ſufficiently obviated by what I have already advanced.

The Doctor's ſecond argument is, That the lips of all animals, even when naturally formed, are ſo cloſely ſhut before their birth, that it is as difficult to open them as their eyes or noſtrils; wherefore the fœtus can receive no part of its nouriſhment by the mouth. But this is an aſſertion againſt experience; for almoſt all fœtuſes when incloſed in the membranes, and ſwimming in the liquor of the amnas, have their mouths more or leſs open, and frequently their tongues hang out.

The learned gentleman's third argument is, that tho' the mouth of the fœtus in utero was open, and allowed to be capable of receiving nouriſhment by it,

(a) L. 1. c. 33. (b) Vol. 2. Obſervat. 32. (c) Regner. Graaf. de Mulier. organ. gener. inſerv. cap. 15.

allowed

yet the liquor of the amnas, in which it ſwims, is not properfood for its ſupport; and this he takes to be ſufficiently eſtabliſhed from the following hiſtory: A certain woman, for ſome conſiderable part of her pregnancy, had laboured under a virulent gonorrhœa; but by proper applications was cured tho' (not long before her time was up) the phyſician who attended being curious to know the circumſtances of her delivery, was informed by the midwife and ſeveral other women then preſent, that when the waters broke, there was a ſtench ſo offenſive, that ſome could ſcarce endure the room; and the midwife aſſured him upon the queſtion, that it was from the waters that ill ſmell aroſe; notwithſtanding this, the child, which is a girl, and is ſtill living, was born well and healthy, but the membranes of the ſecundine were very tender, and almoſt rotten: How can it then be imagined, adds he, that this child could live upon ſuch waters for its food? or how was it poſſible, if it had received any of them into its ſtomach, that they ſhould not contaminate the tender viſcera, ſo as to have deſtroyed the fœtus? But this hiſtory rather ſupports the very contrary doctrine; for the fœtus was in greater hazard of being contaminated by having ſuch nouriſhment ſent immediately into the blood by the umbilic veſſels, than if it had received it by the mouth, for hereby its vitiated qualities might poſſibly have been altered. Hence Pitcairn (a) affirms, that many acid ſubſtances, when taken into the ſtomach, ſoon turn alcalious; and naturaliſts unanimouſly agree, that there are many poiſons, ſuch as that of aſps, vipers, &c. which are innocent when taken by the mouth, but fatal when immediately mixed with the blood (b)

(a) Diſſert. de opera quam præſtant corpora acida vel alkali, in curat. morborum.

(b) Noxia ſerpentum eſt admixto ſanguine peſtis,
Morſu virus habent, & fatum dente minantur,
Pocula morte carent ———————

Lucan. Pharſal. lib. ix.

Non guſtu ſed in vulnere nocet. Celſ. lib. v. cap. 27. See alſo Galen, de Tempera. lib. iii. cap. 2.

It

It muſt indeed be owned, that many poiſons prove deadly, when taken by the mouth, yet experience ſhews that they have more certain and ſudden effects when immediately mixed with the blood. But in this argument, what is innocent when mixed with the blood, is ſuppoſed when fatal taken by the mouth, or elſe that the placenta ſeparates the harmleſs and uſeful from the hurtful, and ſends the one to the amnios, and the other to the fœtus.

The laſt argument is drawn from the analogy betwixt the white of an egg, and the liquor in the amnios. But as what he advances on this head ſtands in oppoſition to the diſcoveries of Malpighius and Bellini, I ſhall make a ſhort parallel between them.

Bellinger maintains (a) that the ventricle is always inſeparably united to the yolk, but never adheres to the white, nor has any paſſages to it that are viſible by a microſcope; and thence concludes that the chick receives all its nouriſhment from the yolk; and therefore infers that the liquor in the amnios in viviparous (which is analogous to the white of the egg in oviparous) creatures, can be of no uſe in the nutrition of their fœtuſes.

But Bellini (b) aſſerts, that a few hours after incubation, the tread leaves the yolk and aſcends to the air-bladder, where it remains till the excluſion of the chick. Malpighius (c) and Bellini demonſtrate that the yolk communicates but little to the chick, till within a few hours before it is hatch'd, when it is drawn in wholly by the inteſtinal duct of Steno, or rather of Needham (d), and by it is conveyed to the ilium, to be voided after its excluſion; and therefore both affirm that the chick is nouriſhed moſtly by the white which is colliquated and forced into its bill by the air-bladder.

(a) p. 49. (b) De mot. cord. prop. ix. (c) De form. pull. & de ovo incub. (d) De for. fœt. c. 4. Plutarch. loco antea citato.

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In the next place, I ſhall take notice of a third way, whereby Alcmæon of Crotona (a) ſuppoſed the fœtus to be nouriſhed, and that was by drawing to itſelf as a ſpunge nouriſhment on all ſides of its body: Beyond all doubt the parts and membranes of animals have an abſorbing quality: Wherefore the fœtus, by taking up ſome portion of the liquor in the amnios, may in part be nouriſhed by the ſurface of the body, during the firſt three months; but after this period theſe inlets are in a great meaſure, if not altogether, obſtructed and covered over with a tough whitiſh matter.

But I haſten to a more probable opinion, that the fœtus is nouriſhed as well by the mouth as by the umbilic veſſels. This notion is as old as Hippocrates, who teaches (b) that nouriſhment is carried by the navel; and elſewhere (c) he maintains, that the child in the womb, with its lips compreſs'd together, attracts nouriſhment, &c. which laſt he enforces with two very maſterly arguments; namely, that unleſs the fœtus had ſucked in utero, it neither could depoſite excrement, nor know how to ſuck, ſo ſoon as it is born. This doctrine ſubſiſted from his time to that of Laurentius (d) and Fabricius ab Aquapendente (e), who brought it into diſcredit, under which it continued till it was revived and well ſupported by Harvey (f), who maintained that the fœtus was nouriſhed both by the umbilic veſſels and by the mouth, with this variation, that Harvey ſubſtituted an albugineous aliment in place of Hippocrates's menſtrual blood. Into which difference, as I am not now to enquire, I ſhall proceed to eſtabliſh this opinion in the beſt manner I can: To do this more accurately, it may be proper to conſider the embryo's gradual growth.

The impregnated ovum being ſhut up in the uterus, fluctuates in the humidities which diſtill from the uterine veſſels, part of which penetrating the coats of the ovum, and paſſing by the pores of the ſkin into

(a) De aliment. §. 7. (b) De carnibus §. 8. (c) Cap. 27. (d) Lib. 8. c. 6. (e) De for. fœt. cap. 8. (f) Exercitat. 57.

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the homuncio (as Alcmæon taught) muſt enlarge both, ſo that their bulk will fill the matrix, and then the beginnings of the veins in the placenta will be implanted into the extremities of the uterine arteries, through which, part of that lymph which before fell into the cavity of the uterus will now be carried to the embryo by the beginnings of the umbilic vein, and what is more than neceſſary is returned by the arteries to the mother; thus for ſome time there is a circulation of lymph until the umbilic veins are ſo much enlarged, that they are capable of receiving red blood from the extremities of the dilated uterine arteries: But when this does fall out, whether about the end of the third month, when abortions moſt frequently happen, is difficult to determine.

This circulation of the lymph, and afterwards of the blood from the mother, to the tender embryo is exceeding languid, being but gently forced along the contorted branches of the capillary arteries of the uterus, and ſlowly propelled through the great length of the umbilic vein by no other force than that of the ſubſequent blood. By which admirable mechaniſm the parts of the weak and tender embryo are preſerved from being injured by the rapid motion of the blood drove upon it by the reiterated pulſations of the arteries. Thus is the embryo nouriſhed in the firſt months. But ſince the liquor ſeparated by the veſſels of the uterus, which do not communicate with thoſe of the placenta, is viſcid, it is made by paſſing thro' the pores of the chorion, and the finer ones of the amnios more fit for the food of the embryo, forming that liquor in which the fœtus ſwims, and which it is evident it takes in by the mouth, for theſe following reaſons.

1. This fluid is a nutritious, not an excrementitious liquor. Hence it is found in a conſiderable quantity (a) before the parts of the fœtus are viſibly delineated. The allantois ſhews that this liquor is deſigned for the food of the fœtus, ſince it prevents the urine

(a) Harv. Exerc. lvi. & lib. de membr. & humor.

from

from mixing with it, and can hardly be ſuppoſed of any other uſe. It has been alledged indeed, that the allantois preſerves the fœtus from being excoriated by the urine; but this would equally happen from the liquor in which it ſwims, if it were, as is alledged, the materia perſpirationis. But farther, as there is no immediate communication betwixt the uterus and impregnated ovum for at leaſt the firſt two months, the fœtus muſt receive its nouriſhment from this juice, whether it paſſes into the fœtus rather through the ſurface of the body than by the mouth. In mares and ſwine there is no communication betwixt the uterus and chorion till they are half gone, which proves this liquor to be a proper nouriſhment for the fœtus. But further, if this liquor was not nutritious, and actually conſumed by the fœtus, more of it would be found in the amnios, at or near the birth, whereas it is then commonly almoſt ſpent.

Secondly, the mouth, nay even its chaſm, is open long before the lips are obſervable, as appears from blowing air on it by a pipe; for then its ſides divide, which yet happens not to the eyelids or ears; and that it continues to be ſo afterwards is evident from an obſervation of Heiſter (a), who in the winter ſeaſon found the liquor of the amnios frozen, and in one continued column, from the mouth to the ſtomach, which not only demonſtrates the liquor in the amnios to be a proper nouriſhment, but alſo that it is conveyed to the fœtus by the mouth.

Thirdly, there are examples (b) of fœtuſes born either without umbilic rope, or with it broke aſunder ſome time before. Hence it appears that the fœtus may be nouriſhed by the mouth without the umbilic veſſels, as well as by the umbilic veſſels without the mouth.

But that the force of all theſe arguments may appear in one view, I ſhall add by way of ſcholium that ſince the fœtuſes of viviparous creatures ſwim in the

(a) Comp. Anat. in Not. p. 247.
(b) Vander Wiel, vol. 2. obſerv. 32.

liquor

liquor of the amnion, (which is undeniably a nutritious juice) and for the moſt part of geſtation have their mouths open, it may be ſafely concluded, a priori, that part of this liquor enters that paſſage; and ſince the very ſame liquor is actually found in the mouth and ſtomach, and ſince there is ſometimes no connexion between the mother and fœtus by means of the umbilic rope, whereby it can be ſuſtained, it may likewiſe be affirmed, a poſteriori, that the fœtus has part of its nouriſhment from the liquor of the amnios, and that it is conveyed to it by the mouth.

But further, the liquor contained in the amnios, and that found in the ſtomach of the fœtus agree in colour, ſmell, taſte and every other ſenſible quality, excepting that the latter is more gelatinous, ſome of its thinner parts being ſucked up by the abſorbent veſſels of the ſtomach. This liquor continues to grow thicker in its paſſage through the inteſtines, the nutritious particles being taken up by the lacteals, till at laſt, in the larger ones, it is very much thickened; then it changes its colour by the mixture of the bile and pancreatic juice, and acquires the name of meconium from its complexion and conſiſtence. In the laſt months the liquor in the amnios grows thinner, being conquaſſated by the motions of the mother and of the fœtus. At this time it acquires a ſaline or urinous taſte, but this injures not its nutritive quality. For ſome time after incubation, the viſcidity of the white of an egg is attenuated, and its inſipid and inodorous ſubſtance changed into a ſaline and ſtrong-ſmelling liquor.

I have all along choſen rather to reaſon from facts, than to introduce arguments depending upon uncertain hypotheſes; yet ſince nature is always obſerved to act after a very uniform manner, I ſhall, in order to illuſtrate this ſubject further, ſubjoin two analogical arguments. The firſt is taken from the analogy between the vegetation of infant plants and nutrition of animal fœtuſes. Plants in ſemine have two different roots; firſt the ſeminal whoſe fibres are inſerted into the

the cotyledons of the ſeed, to convey to the plant its firſt nouriſhment from the mother earth, and by which it is gradually extended, till it ſhoots out its ſecond or plantal root, whereby it more immediately receives ſap or nouriſhment from the ground; and thus for ſome time being ſupplied by both, the plantal root becomes at laſt large enough to nouriſh it alone; and then there being no more occaſion for the cotyledons, they die and fall off. Juſt ſo the fœtuſes of animals have two roots (if I may be indulged in the ſimile) the umbilic veſſels which by the intervention of the cotyledons or placenta, derive a liquor from the mother for its nouriſhment, which are gradually increaſed till the mouth and viſcera (the ſecond root) be formed and enlarged to receive part of the aliment alſo; then they continue to be ſuſtained both ways, till they become ready for the birth, when the ſeminal root the cotyledons fall off, or the placenta is ſeparated, and the infant born when it is able to be wholly ſupplied by its mouth or plantal root.

The laſt analogical argument is taken from the apparatus for nouriſhing the chick in the egg, where there is a ſimilar liquor, as well as veſſels, deſigned for the ſame uſes, as in animals. Thus the white is colliquated gradually by the air-bladder and the heat of incubation, and ſent into the tread or amnios for the nouriſhment of the chick; as in animals the liquor of the amnios is elaborated and fitted for the aliment of the fœtus, by paſſing through the pores of the chorion and amnios, the white is always found in the mouth and gizzard of the chick, as the liquor of the amnios is obſerved in the mouth and ſtomach of the fœtus. The white is entirely conſumed in the nouriſhment of the chick, before it is hatched, and very little of the liquor of the amnios is left at the birth of the child.

Upon the whole, the liquor of the amnios in which the fœtuſes of viviparous creatures ſwim, ſerves for the ſame uſeful purpoſes as the white of the egg in the oviparous kind, and both are carried to their young in the ſame way, that is by the mouth.

An eſſay on the nutrition of fœtuſes by ALEXANDER MONRO, *Profeſſor of Anatomy in the Univerſity of Edinburgh and F. R. S.* vol. 2. art. 9.

THE nouriſhment of the fœtus after it is formed is allowed by all either to paſs from the amnios by the mouth into its chylopoietic organs; or to be conveyed into its blood-veſſels by means of the umbilical veſſels; or to be nouriſhed by both.

The determination of the queſtion as now ſtated may be reduced to the ſolution of the few following problems.

I. How far the mouth or umbilical veſſels are neceſſary to the nouriſhment of fœtuſes.

II. Whether the liquor of the amnios be proper food for a fœtus.

III. Whether this liquor paſſes into the ſtomach of a fœtus.

I ſhall take notice only of well vouched facts, and reaſonable conſequences from them, for on theſe only it is that a rational foundation of any part of medicine can be laid. The firſt thing therefore which I ſhall do is to ſet down ſuch facts as I may have occaſion to aſſume in my ſubſequent reaſoning, together with ſome others ſerving either to confirm or eſtabliſh thoſe, or to render them more clear and intelligible.

That the truth of theſe facts may be more unqueſtionable, I ſhall either point out the manner in which others may obſerve them, or where I had not the opportunity of an exact examination myſelf, I ſhall quote my vouchers. And if the being or ſtructure of things are not demonſtrable to the ſight at any time and affirmed, I ſhall ſet down other facts from which they ſeem to be plainly and neceſſarily concluded to be true. I ſhall not enter into particular minute deſcriptions, but refer to the books where ſuch deſcriptions are to be met with.

The

The preliminary facts.

1. The human uterus has numerous orifices of veſſels opening into its cavities to pour out liquors therein (a).

Theſe liquors may at any time be ſeen ouzing out, by gently preſſing the ſubſtance of an opened uterus.

2. Towards the fundus of the womb eſpecially, theſe orifices are found to be the extremities of canals which come out from larger cavities lodged within the ſubſtance of the womb; theſe cavities are commonly called ſinuſes (b).

3. The ſinuſes are much of the ſame texture with the corpora cavernoſa penis, being membranous cavities communicating with each other, and having numerous arteries ſpread on them, whoſe lateral branches open into the cells, from which veins go out to be joined to other veins which return the blood from the other parts of the womb (c).

4. Theſe ſinuſes are diſtended with blood in the time of the menſes, when their orifices alſo are enlarged (d). I have ſeen this in ſeveral bodies which I diſſected.

5. During the time of pregnancy, the ſinuſes and their canals which open into the womb are gradually diſtended and enlarged.

In a woman who died three or four months gone with child, I ſaw the orifices of theſe canals large enough to receive a gooſe-quill, the ſinuſes being conſiderably larger. At the end of nine months the ſinuſes will contain the largeſt (e), and the canals from them will receive the little finger (f).

(a) Tho. Bartholin. anat. reform. lib. 1. cap. 28. Santorin. obſerv. anat. cap. xi. § 11. (b) Bartholin. anat. reform. lib. 1. cap. 28. Morgagn. adverſ. anat. 10. animad. 26, 27. (c) Malpig. in epiſt. ad Spon. Littre in memoires de l'acad. des ſciences, 1701. (d) Bartholin. anat. reform. lib. 1. cap. 28. Morgagn. adverſ. anat. 1. § 33. Ad. iv. § 27. (e) Santorin. obſerv. anat. cap. xi. § 9. Morgagn. adv. anat. i. § 26. (f) Morgagn. ibid.

6. Besides the reticular bundles of muscular fibres, which enter into the structure of the womb (a) I have seen Ruysch's orbicular muscle at its fundus (b).

7. The placenta generally adheres to, or near to the fundus of the womb. All agree in this. In two women with child whom I dissected, the placenta adhered principally to the anterior part of the fundus.

8. The placenta is covered on the side next to the womb with a fine membranous continuation of the chorion (c). I saw this distinctly in both the subjects I dissected.

9. The extremities of the umbilical vessels pierce this membrane, and shew their very small orifices on its side next to the uterus; and therefore it is compared to the villous coat of the intestines (d).

10. The allantois was carefully sought for, in both the subjects which I opened; but we could see no such cavity, nor liquor in it. The membranes had a loose connexion, by a cellular substance, and a fine transparent membrane was observed between the chorion and amnios.

11. The uteri of other animals have vessels opening into their cavities as well as the human womb, and the same trial discovers them.

12. The membranous continuation of the chorion has not yet been discovered on the exterior surface of the placenta of brutes; but their secundines have numerous orifices of the umbilical vessels opening on their surfaces next to the uterus, as is evidently demonstrated by injecting a thin liquor into the umbilical vein or arteries; for it soon comes running out every where from the exterior surface of the placenta and chorion.

13. The mother supplies liquors to the fœtus, which returns others to the mother by means of the uterine and umbilical vessels.

This seems to be plainly proved by observations. Fœtuses whose placentæ were not in the least sepa-

(a) Malpigh. in epist. ad Spon. (b) Ruysch. epist. de musc. in fundo uteri. (c) Ruysch. Thes. anat. 11. asser. 4. n. 18. not. 1. & Thes. 5. n. 41. Santorin observ. anat. cap. xi. § 11. (d) Ruysch. Thes. 5. n. 41. Rohault, Mem. de l'acad. des sciences, 1714 & 1716.

rated

rated from the uterus, have been quite exhaufted of blood by the mother's dying of an hæmorrhage (a), and I have feen children pale and weak by violent floodings in the time of labour.

14. When a fœtus dies or is feparated from its fecundines by cutting the umbilic rope, the circulation of liquors is fully ftopt in the veffels of the fecundines, and thefe become a lifelefs mafs.

Experience fufficiently proves this. No hæmorrhage, or difcharge of any other liquor happens at the umbilical veffels, upon the navel-ftring's being cut or broke, after the veffels are fecured on the fide of the child, as I have feen frequently; and another proof is the placenta commonly feparating in a fhrivelled or fuppurated ftate, foon after the communication with the child is deftroyed (b).

In obferving whether the umbilical veffels have a circulation of blood kept up in them after their communication with the child is ftopt or deftroyed, care ought to be taken that no fœtus is left with its navel-ftring untied or uncut; for in the cafe of twins, when often the placenta are blended, and fometimes one navel-ftring ferves both (c) though one child is taken away, the other may fill the veffels of the placenta, and continue their functions, fo that an hæmorrhage would happen at the cut but untied navel-ftring of the firft child. We have an inftance of a mother and child being almoft drained of their blood, by the midwife's neglecting to tie the navel-ftring of the firft of the twins, which was brought forth without perceiving that the other ftill remained in the womb.

15. The power whereby the fmall open orifices of veffels imbibe liquors lodged in the cavities of the body, increafes or diminifhes proportionally to the ftrength or weaknefs of the creature.

(a) Mery dans l'hift. de l'acad. des fciences 1708. Heifter. compend. anat. not. 36. (b) Mauriceau maladies des femmes groffes, livre ii. chap. 9. Ruyfch. in Thef. obf. & adverf. (c) Mem. de l'acad. des fciences, 1720. Act. Medic. Berolin. dec. 2. vol. 6. § 4. (d) Hift. de l'acad. des fciences, 1727.

In diseases where the contraction of the vessels is too great, there is scarce so much mixture in the cavities or interstices of the parts, as allows them to slide easily one upon another. In health the quantity of such liquors is moderate, and a pretty constant equality is kept between the action of the exhalants and of the absorbents, but when the body turns weak the exhalants pour out so much more than the absorbents can take in; then all the cavities are found to contain considerable quantities of liquors; after death the action of the absorbents seldom or never can be supplied by any mechanical pressure. For examples of what has been said concerning absorption, consider the common phænomena which are to be observed in the long alimentary tube, in the large cavities of the tunica cellularis every where, of the cornea, &c. both in a sound and morbid state. Hence we may understand how purgatives or diuretics may serve to drain off extravasated waters, by stimulating the vessels to a stronger absorption, and how corroborants may produce the like effect, though more slowly.

16. The liquors (§ 13) are not carried from the mother to the fœtus, or from the fœtus to the mother by continued canals, that is, the uterine arteries and veins are not joined by an anastomosis with the veins and arteries of the secundines (a); but the extremities of the umbilical vein take up the liquor by absorption, in the same way as the lacteal vessels do in the guts; and the umbilical arteries pour their liquors into the large cavities of the sinuses or other cavities analogous to them.

It is plain from the disproportionate size of the human sinuses, and of their excretory canals, to the very small extreme umbilical vessels (compare § 5 and 9) that there can be no anastomosis by continued canals supposed here, which also seems to be proved next to a demonstration by § 14; for if the vessels of the secundines were joined by an anastomosis to the uterine,

(a) Harvey de generat. animal. exercit. 70. Ruysch. Thes. 5. n. n. 41.

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an hæmorrhage or flux of ſome liquors would happen at the umbilical vein whenever the navel-ſtring was broke or cut, and would continue as long as the after-burthen adhered to the uterus; and if the umbilical veſſels were tied, the circulation would ſtill continue in the placenta, and it would not become a lifeleſs maſs; but the reverſe of all theſe are obſerved, a ſure proof of the communication of the placenta with the uterus being deſtroyed as ſoon as the navel-ſtring is divided; and as § 14 ſhews the ſecundines to owe their life and action to the fœtus; ſo the reaſon of their taking in no fluids, after it is ſeparated, is evident from § 15.

In brutes we can obſerve no tearing or breaking of veſſels when we ſeparate the placentæ from their uteri; and when any liquor is injected into their uterine arteries, none of it paſſes into the umbilical veſſels, as I have often tried in the glanduliferous animals, cows, ſheep, &c. and in ſome others. In many animals the ſecundines and uterus do not adhere for a conſiderable time (a); and in ſome of theſe, mares for inſtance, (b) there is no way for any nouriſhment to be conveyed to the fœtus except by the veſſels of the ſecundines, which therefore can only take up their liquors by abſorption; may not the ſame obtain in other animals?

'Tis worth while to remark by the way the inconveniencies which are ſhunned by the want of an anaſtomoſis between the veſſels of the womb and ſecundines. The violence of the mother's circulating fluids are not in hazard of deſtroying the embryo while tender; and there are no veſſels to be broken or torn at birth, which would have required too much force in bringing away the placenta, and brought on inflammation, ſuppuration, and other bad ſymptoms.

Some who contend for an anaſtomoſis, to avoid theſe inconveniencies, will not allow the canals to be of one continued ſubſtance, but ſuppoſe the veſſels of the uterus and ſecundines to be joined only per appo-

(a) Fabr. ab aquapend. de form. fœt. part. 1. cap. 3. Needham, obſ. anat. cap. 2. (b) Needh. ibid. & cap 3.

ſitionem, one ſort receiving the other within them (a), ſo that the coats of the veſſels being contiguous, they ſerve for the tranſmiſſion of liquors, and may be pulled from each other with a ſmall force, and without any laceration. But the arguments uſed againſt the anaſtomoſis, or propulſion of liquors from the mother into the branches of the umbilical vein are of equal force againſt this hypotheſis; at the ſame time the viſible diſproportion of the oppoſite human veſſels ſhew its abſurdity; in other creatures the chances of unfitneſs are much greater than thoſe of their being adapted to each other. If the cure of wounds by ſymphyſis is brought to illuſtrate this doctrine by, it ought to be conſidered how ſoon the change from contiguous to continued veſſels is made. But there are ſome obſervations and experiments which may be inſiſted on as a clear evidence againſt me, if their force is not taken off; therefore I ſhall ſtate ſuch objections with their anſwers. Mr. Mery (b) deſcribes a child who had no heart, lungs, &c. nor any thing analogous to heart, and therefore cannot conceive any other force which could continue the circulation in this monſter than the motion acquired from the uterine arteries, which according to him muſt have inoſculated with the placentary veſſels. But as this monſter was twin to a perfect child whoſe funis umbilicalis ſent off the ſmall navel-ſtring of the monſter, the heart of the compleat child was able to drive forward the blood of them both, without any aſſiſtance from the mother.

Mr. Cowper (c) has a paſſage which ſeems to ſupport the contrary of what I have aſſerted. "Theſe "blood-veſſels of the uterus, ſays he, are inoſculated "with thoſe of the placenta, as may appear by the "paſſing of mercury from the one to the other; ſo that "if you pour it into the hypogaſtric arteries of the mo-"ther it will paſs into the veins of the placenta, as well "as thoſe of the uterus:" And on the contrary, from the

(a) See art. ix. of the firſt volume. (b) Mem. de l'acad. des ſciences, 1720. (c) Anatomy of human bodies, explic. of tab. 54. F. F. F.

arteries

arteries of the placenta to the hypogaſtric veins of the mother, as alſo into the veins of the placenta. Hence it appears there is a circulation of blood between the mother and fœtus; and it ſeems as if the blood-veſſels of both did terminate and inoſculate with each other. But this requires too much ſpeculation for my occaſions to admit of a further enquiry at preſent. But this author appears rather to aſſert what he thinks would happen, than to deſcribe what he really ſaw. Drake affirms, that Mr. Cowper proved the anaſtomoſis between the veſſels of the womb and ſecundines; for ſays he, by pouring mercury into a branch of the uterine artery of a cow which went into one of the cotyledons of the uterus, he filled thoſe branches of the umbilical veins, which went from that cotyledon to the navel of the fœtus which, with a part of the uterus, he keeps prepared by him ——After Drake has mentioned what is above, he goes on to ſhew, from the analogy of the parts, how weak an objection it would be to alledge, that the obſervation and experiment being made on the uterus of a cow, the inference would not hold from thence in a woman: From which it would appear that I judged right of Mr. Cowper's not having ſeen what he ſo looſely affirms, in the paſſage quoted from his great anatomy, concerning the communication between the human uterus and placenta being proved by the pouring in of mercury. Cowper takes no notice of this preparation, though he mentions ſome other preparations of the ſame parts in cows—I have tried the experiment a great many times, but never could force one drop of quickſilver into any branch of the umbilical veins, though it paſſed from the cotyledons into the ſubſtance of the placentulæ, that is into the interſtices of their unequal ſurface, and the weight of the mercury ſeparated the placentulæ from the cotyledons. Therefore Drake muſt have made ſome miſtake, or Cowper's ſubject had theſe veſſels diſpoſed differently from what they are commonly in cows. His words are remarkably dubious and timid. But to take away all pretence for

inſiſting

insisting on this assertion as a conclusive experiment, I injected oil of turpentine into the iliac artery of a woman three or four months gone with child. The return of the oil by the artery of the other side or by the veins was prevented; and the oil pushed in till the uterus was so swelled that the vessels seemed to be in hazard of bursting. When the uterus was opened, the umbilical vessels were found empty, and neither any particles of oil could be perceived, or its taste in the coagulated blood scattered in the veins; nor were there any marks of it in any part of the fœtus.

Mangetus has recorded a more express experiment, which he says Vieussens communicated to him. It is this. Quicksilver injected into the carotid artery of a bitch with young, not only ran into all her members and bowels, but likewise came so by the umbilical vein into the whelps inclosed in the uterus that their interior and external parts, and consequently the whole skin, were painted with the mercury running through the blood-vessels. But Mr. Vieussens has mentioned nothing of this experiment, when he expresly treats this very question, and Morgagni has sufficiently shewn how intolerably inaccurate a writer Mangetus was. In a Geneva edition of Verheyen's anatomy, Vieussen's says, he tied the left carotid artery of a living bitch with young, and then poured at different times four pounds of quicksilver into the right carotid. The creature appeared quite dead, and he dissected her, and found that the mercury without breaking any vessel or the effusion of one drop of blood, passed through the placenta surrounding each whelp, and was pushed into the umbilical vessels themselves. And in another treatise printed also in Verheyen's anatomy, he says, mercury being poured into the right carotid artery of a bitch about two months gone with whelp, the left carotid being tied, passed into the umbilical vein of the whelps without any breaking of the vessels.

Vieussens's experiment seems strangely contrived; for by tying one carotid, and pouring mercury into the other, he left only the vertebral arteries to propel the

the blood and quickſilver through the veſſels of the head, from which they were to be diſtributed through the whole body. Some of the blood of the vertebrals muſt have had a retrograde motion into the carotids by their anaſtomoſis to hinder the entry of the quickſilver. And if the head of the bitch was laid ſo depending, as that the weight of the mercury could overcome the reſiſtance of that blood, then it muſt have paſſed through the tender ſmall arterious veſſels of the brain, and have aſcended in the veins. The quickſilver is ſaid in looſe words to have paſſed through the placenta, and to have been puſhed into the umbilical veſſels, which the appearances in the dead bitch on which I made the trial of this anaſtomoſis might eaſily have led them to think, though a nicer examination would have diſcovered his miſtake. I endeavoured lately to imitate Vieuſſens's experiment on a living bitch, but the creature dying before any ſucceſs could be expected, I immediately repeated the trial I had formerly made, and with the ſame ſucceſs, not one drop of quickſilver being ſeen in any branch of the umbilical veſſels of five whelps which the uterus contained, though not only the arteries but the veins alſo of the womb were diſtended with mercury. Nay Vieuſſens's words taken in the moſt favourable ſenſe are not concluſive for an anaſtomoſis, becauſe while the mother and fœtuſes were alive ſome of the quickſilver might be taken up by the abſorbent veſſels of the placenta. I repeated it. I put a pipe into the carotid artery of a bitch, without cutting more of the teguments than was neceſſary to come at the artery; then hanged up the bitch by the neck and poured in the quickſilver, till it came running plentifully out at the vagina, which was afterwards tied firmly, and mercury continued to be poured in at the carotid. On opening the bitch, the veſſels of the uterus and its cornua were found turgid with quickſilver. The body of the uterus and right cornu contained no fœtus, but were diſtended with extravaſated quickſilver. One whelp was contained in the left cornu, which was taken

taken out and laid on a plate, after being well tied above and below where the fœtus was lodged. When this cornu was cut longitudinally, the placenta ſeparated from it moſt eaſily; and as they ſeparated, the mercury run out plentifully from the veſſels of the cornu, but not a drop appeared in, or drilled out of any veſſel on the exterior ſurface of the placenta. After the amnios was opened, there was no mercury to be ſeen in the fœtus or the umbilical veſſels.

This doctrine of abſorption by the umbilical veins appears to me clearly proved by what has been advanced in this ſection; but as it may ſomewhat ſhorten the diſpute concerning the nouriſhment of a fœtus, the following remark may be conveniently added, that if only ſome of the veſſels are abſorbents (the contrary of which cannot be made out) they will ſufficiently prove as much as is neceſſary for the preſent purpoſe.

17. The red particles of the blood are probably not abſorbed by the extremities of the umbilical vein. Vieuſſens will not allow that any red globules paſs from the mother to the fœtus, or from the fœtus to the mother. In confirmation of which I ſhall relate what I obſerved lately in injecting a human placenta, the membrane of which on the ſide next to the uterus was entire. After I had forced out the blood, by macerating it in warm water, and injecting ſuch water by one of the umbilical arteries, I tied the other artery and the vein by which the water had returned, and then turning the villous ſide of the placenta uppermoſt, I injected more water. The water ouzed out at imperceptible orifices exceeding ſlowly. I afterwards preſſed the water out of the veſſels as much as I could, and injected oil of turpentine coloured with vermilion, which returned by the vein in a fainter colour than it was in the arteries; I could make very little of the oil ouze out at the villous coat, and what did come out was not in the leaſt tinged. The coarſer injection being afterwards thrown into one of the arteries, filled both, but did not return by the vein, which I filled with the green injecting liquor.

My reaſons for thinking ſo are: The ſmallneſs of the orifices of theſe veſſels; the chylous appearance of what is ſeparated from the glands of cows and ſheep, and the want of an example of red globules being abſorbed any where elſe.

Whence then has the fœtus the red blood? The fœtuſes of viviparous animals have their red blood from the ſame ſource that chickens in eggs have theirs, the action of their heart and the veſſels in their body and ſecundines.

If it ſhould be objected that the inſtances mentioned § 13 of children being exhauſted of blood by hæmorrhagies from the mother's veſſels, ſhew the red blood to be ſent out from the ſecundines into the uterus; and therefore probably ſuch are taken in; the anſwer is, that theſe inſtances prove the loſs of ſuch red particles no more than the wan colour, faintneſs, and the emptineſs of the veſſels in a violent diarrhœa are certain ſigns of bloody ſtools.

18. The placenta does not increaſe in the ſame proportion which the fœtus does; for the ſmaller the fœtus is, the larger proportionally is the placenta (a).

The ſmaller ſhare by far of the blood ſent out by the umbilical arteries is returned to the uterus, moſt of it being poured into the umbilical vein by inoſculating canals.

This may be ſeen by injecting liquors into the umbilical arteries of any creature. Rohault (b) calculates, that only one ſeventh part of the capillary branches of the human umbilical veſſels reach the exterior ſurface of the placenta.

20. The progreſſive motion communicated to liquors by the power of abſorption being ſlow and weak, and no external alternate preſſure having a conſiderable effect in increaſing the momentum of the liquors moving in the veſſels contained within the uterus, the blood returning to the fœtus muſt be puſhed forward principally by the force of the heart and arteries of the fœtus itſelf.

(a) Ruyſch. ſparſim. (b) Mem. de l'acad. des ſciences, 1715.

That the force of the heart may be ſtrong enough to drive forward the blood in ſuch a long courſe as it muſt make in the ſecundines, the canalis arterioſus is ſent from the pulmonary into the deſcending aorta, whereby the blood thrown out from the umbilical arteries is propelled by the united force of both right and left ventricles of the heart, and theſe arteries inoſculate with the branches of the umbilical vein by large canals.

21. In the greater number of animals which have hitherto been carefully examined, the allantoid membrane with its contained urine has been found (a).

22. The allantois of ſome animals (mares, bitches, cats) ſurrounds the amnios, being every where interpoſed between it and the chorion. In others (cows, ſheep, goats) the allantois incloſes a conſiderable ſhare of the amnios. And in others (ſwine, rabbets) it is confined to a ſmall ſpace.

23. At thoſe places where the allantois is not interpoſed between the other membranes of the fœtus, the chorion adheres to the amnios by a very fine cellular ſubſtance, which eaſily yields to any ſtretching force, as is viſible in the ſecundines.

24. The amnios has numerous ramifications of the umbilical veſſels ſpread upon it, the orifices of the lateral branches of theſe arteries pouring out liquors into its cavity.

This is plainly proved by injecting water into the umbilical arteries, which will come out on the ſurface as ſmall drops. I have many times repeated this experiment with ſucceſs.

25. Since there are veins on the amnios, and ſince the veins of all other membranous bags which have arterious canals throwing liquors into their cavity, abſorb fluids from the cavity, we may conclude, that the veins here are the ſame way employed.

26. The liquor contained in the amnios is either wholly ſeparated from it or is furniſhed partly from it, and in part from the fœtus.

(a) Needham, obſerv. anat. de form. fœt. cap. 3.

In

In the creatures whofe amnios is every where inclofed by the allantois, (§ 22) it is impoffible this liquor can be tranfcolated from the uterus through all the membranes into the cavity of the amnios, becaufe if the allantois allowed a paffage to fuch a fluid, its own contents muft neceffarily go along with it, which would be of bad confequence. In thofe creatures where the allantois only furrounds part of the amnios, if we fuppofed the amnios and chorion capable every where elfe of ferving as ftrainers, the liquor would always be found in confiderable quantity in the cellular fubftance between them (§ 23) which it is not; and what fhould hinder it to run out as faft as it could be conveyed in?

Harvey's obfervation of this liquor (a) of the amnios being feen in large quantity before the fœtus is formed, may probably be objected as a fure argument of its being derived from fomewhere elfe than the umbilical veffels, or furface of the fœtus; and that can only be from the cavity of the uterus by tranfcolation. But all that can be made of Harvey's affertion is only this negative, that he did not fee a fœtus in the very fmall conceptions he examined; but it is evident from later obfervations (b) that the rudiments of a fœtus and its funis umbilicalis may be feen much fooner and in lefs conceptions; extrauterine fœtufes prove clearly that the embryo is always much fooner lodged in its fecundines than the parts of thefe are difcernible. The liquor of the amnios is in larger proportional quantity, the younger a conception is; and the reafon of this may eafily be underftood from § 15. From the obfervation itfelf compared with this fection, I would infer that the veffels of the amnios furnifh by much the larger fhare of the liquor contained in it.

27. As foon almoft as the embryo is difcernible, its umbilical veffels difcover themfelves (c).

(a) De generat. animal. exercit. 56. (b) Compare Harvey's exercit. 15, 16, 17, with Malpighius de ovo incubato in the firft three or four days of incubation, and his exercit. 56. with Kerkring. Anthropogr. Ichnogr. and Ruyfch. Thef. 6. (c) Harv. Exercit. 56. Ruyfch. thef. 6. & paffim. Riolan. Anthropogr. lib. 6. cap. ult.

28. The mouth, lips and cheeks of fœtuſes are at firſt wanting, and leave a large chaſm inſtead of a mouth, which is gradually contracted by the formation and conjunctions of theſe parts, till it is brought to a due ſize (a).

29. While fœtuſes continue in the womb, their muſcles commonly act only by their natural contraction; but ſometimes when the eaſe of the fœtus or its preſervation requires a change of ſituation, it ſeems to perform ſome voluntary motions called it's ſtirrings.

The poſture of a child is owing to the muſcles being left to their natural contractions, the ſtronger ones always prevailing till their antagoniſts exert ſuch a reſiſtance, by being ſtretched, as brings them to an equilibrium. Hence the ſpine is bowed forward; the head bended towards the knees; the thighs are brought forward; the legs bended back; the arms hang down, but are drawn a little forward; the fore-arms, hands and fingers are all bended, and thereby the hands are placed round the knees.

30. The ſtomach of the youngeſt fœtuſes are full of a mucous liquor, which remains of near the ſame conſiſtence all the time of geſtation, except as it becomes gradually ſomewhat more viſcous as the fœtus increaſes. This has obtained in all the different animals which I have diſſected.

31. The ſmall guts of fœtuſes are full of a liquor reſembling the whites of eggs, which becomes thicker and darker coloured as it deſcends to the great guts.

32. Fœtuſes increaſe proportionally leſs, the longer they continue in the womb.

Mauriceau (a) pretends to determine the proportional increaſe of a child to be ſixty-four times its own weight in triple the time. At the birth, twelve pounds; at three months, three ounces; at one month, three fourth parts of half a dram; and at ten days, leſs than half a grain.

(a) Harvey ibid.

Having

Having now eſtabliſhed the neceſſary facts, I deſign to uſe them hereafter as ſo many axioms; and to ſave repetitions, ſhall only refer to them by the numbers prefixed to each, in the ſolution of the ſeveral problems, to which I return.

PROBLEM I.

How far the mouth or the umbilical veſſels are neceſſary to the nouriſhment of fœtuſes.

SEveral fœtuſes, born without mouths, being found on examination to have another paſſage from the ſurface of their bodies to their ſtomach, have induced authors of good account to aſſert the univerſality of theſe vicarious paſſages, and bring that as an argument for the nutrition of fœtuſes by the mouth: But others have given accurate and well-vouched hiſtories of monſters who had no ſuch paſſages.

Three children (a), a whelp (b), and a lamb (c), were brought forth without heads or any paſſage into the chylopoietic bowels. Others, with heads, had no paſſage to the ſtomach (d). Some who had a paſſage into the ſtomach, wanted inteſtines (e); and into the inteſtines of others nothing could get down (f).

Theſe examples ſhew the little neceſſity there is for either mouth or chylopoietic organs in the nouriſhment of fœtuſes, yet ſome who are of opinion that it is conveyed by both the umbilical vein and the mouth, undertake to prove that the ſupply by the navel may be wanting, as well as that by the mouth; and therefore that both contributing towards the nouriſhment in the natural ſtate of the fœtus, whenever one of them is wanting, the other performs the function of both,

(a) Littre Mem. de l'acad. des ſciences, 1701. Mery, ibid. 1720. Buchnerus, act. med. phyſic. acad. n. c. vol. 2. obſ. 96. (b) De Graaf. de mulier. organ. cap. 15. Littre hiſt. de l'acad. des ſciences, 1703. Brady Phil. Tranſ. n. 304. (c) Antoine hiſt. de l'acad. des ſciences, 1703. Ruyſch. Theſ. 4. n. 55. (d) Bellinger de fœt. nutr. chap. 9. (e) Lemery hiſt. de l'acad. des ſciences, 1704. (f) Calder, Medical Eſſays, vol. I. art. 14.

as is ſometimes done in other parts of the body. But I muſt inſiſt particularly on the ſeveral facts advanced in proof of the navel not being indiſpenſably neceſſary towards the nouriſhment of a fœtus. The firſt argument brought in favour of this opinion, is, that Harvey, Needham, de Graaf, who diſſected viviparous animals with young, aſſure us there is no adheſion or connexion between the ſecundines and uterus of moſt animals, for a conſiderable time after conception, and in ſome animals many months paſs before there is any adheſion; and that therefore the fœtus can receive nothing at this time from the mother by the umbilical veſſels, and conſequently is then wholly nouriſhed by the mouth. This argument, on ſuppoſition that the uterine veſſels muſt inoſculate with thoſe of the ſecundines, before the umbilical can receive any liquors from them, is indeed of great force; but according to the ſcheme explained, and I hope proved, § 13——16 of preliminary facts, it is a matter of indifference whether the liquors furniſhed by the mother are applied to the bibulous orifices of the abſorbent veſſels of the ſecundines, while the liquors are contained within cells formed in the ſubſtance of the uterus, (§ 2— 5.) or whether they are poured into the cavity of the uterus itſelf; for theſe veſſels will equally perform their office in both caſes, and thereby ſerve to nouriſh the fœtus ſufficiently, which takes off the neceſſity of ſuppoſing the food to be wholly received by the mouth. In ſome animals (mares for example) whoſe allantois ſurrounds the amnios (§ 22) and whoſe ſecundines have no connexion for a conſiderable time with the uterus, this is finely illuſtrated, and the fœtuſes nouriſhment being conveyed by the umbilical veſſels fully demonſtrated.

Next, ſeveral obſervations are brought to ſhew that the paſſage of liquors by the navel, has often been ſtopt long before birth. In the memoirs of the academy of ſciences, (a) an account is given of a navel-ſtring which had a knot in its middle. But there is no mention

(a) Hiſt. de l'acad. des ſciences, 1718.

made

made of the child's condition, whether it was born dead or alive, nor any other circumſtance by which it can be known whether this knot ſtopt the courſe of the blood, or whether it was any other than the common knot which midwives make ſo much ado about. Through ſuch injections ſhew that liquors will paſs. In plate III. fig. 5. is repreſented a piece of a navel-ſtring whoſe veſſels are diſtended with wax. A A is the large vein; B B the two arteries twiſting ſpirally round the vein; C a very remarkable convolution of the arteries, which reſembled a knot before the injection was thrown in. From the whole, this obſervation is of no uſe in the preſent argument; and the obſervation of children ſaid to be killed by knots of the navel-ſtring are as little to my purpoſe; for though the authors who relate them aver the knots to be the cauſe of death; yet they do not mention circumſtances in the fact ſufficient to ſupport their opinion

The ſecond obſervation brought to prove the courſe of the blood interrupted in the umbilical veſſels before birth, is what Heiſter quotes from Hoffman's diſſertation de pinguedine. A perfect child was born whoſe umbilical rope was all corrupt. Mr. Heiſter adds, it would have been impoſſible that it ſhould have lived unleſs it had taken its nouriſhment ſome other way than by the navel.

It does not appear from this account whether the child was born dead or alive, nor how long the navel-ſtring had been corrupted, nor what parts deſtroyed by the putrefaction, whether the cellular membrane and mucus of the rope only were affected, or if the veſſels involved in them were alſo deſtroyed. How can the total and compleat corruption of the membranes, mucus and veſſels be reconciled with any appearance of the umbilical rope?

Chatton and Petrus Ramelius relate two hiſtories which agree almoſt exactly in the principal circumſtances. Healthy children were born with the navel ſkinned over. The ſecundines were of a natural ſize; the extremities of the umbilic rope coaleſced. This

circumſtance of the ſecundines being of a natural ſize ſhews, that this accident did not happen long before birth. See § 14. After birth children's navels are ſoon ſkinned over; I have frequently ſeen the tied piece of the navel-ſtring fall off in two or three days, and the part ſound where the ſhrivelled ſkin ſeparated; and it is extremely probable that the ſkin would be much ſooner brought on the navel when it was ſoaking in the liquor of the amnios: We have a very convincing proof of the effect of ſuch a ſalt liquor in the ſaliva, which not only ſerves to keep the mouth ſoft and flexible, but very ſoon heals wounds or mild abſceſſes there. The urine will ſcarce allow ſurgeons to keep the wound in lithotomy long enough freſh, while notwithſtanding their utmoſt efforts it often renders the paſſage callous. From all which I conclude, that theſe navel-ſtrings were broke not a long time before birth, and if a day or two, the fœtus might continue ſo long alive without any new ſupplies of nouriſhment, as well as it does ſeveral days after birth, when it ordinarily takes only ſome purging ſyrups, and there is recorded (a) an inſtance of a child who lived ſeven days after birth, though nothing could paſs out of its ſtomach into its guts to nouriſh it. The probability of a child's living in the womb ſo long without nouriſhment is certainly much greater than that it ſhould live weeks or months after the waters have been evacuated, and continued to be conſtantly diſcharged (b), on the ſuppoſition of its receiving its food moſtly by the mouth for ſome time before birth. I therefore conclude from the whole, that theſe children were under no neceſſity of being ſupplied with nouriſhment any other way than by the navel.

A more direct proof of the umbilical veſſels not being neceſſary is offered by two examples of fœtuſes who had no navel-ſtring. The one is told by Vander Wiel, who ſays (c). In the time of the fair at the

(a) Medical Eſſays, vol. art. (b) Mauriceau dans pluſieurs obſervat. (c) Obſerv. cant poſt. pars. i. obſerv. 32.

Hague, in the year 1683, a male child, a year and three months old, born of poor parents in February 1682, was expoſed for a ſhew. When it was born, there was not the leaſt veſtige of the umbilical rope the navel alſo was wanting; but inſtead of it a broad round red ſpot, as large as a ſtiver piece of money, covered with a very thick ſkin, appeared in the hypogaſtrium, near the ſharebones; within the circumference of which ſpot two papillulæ or aquæducts were ſeen, at an inch diſtance from each other, by which the urine was evacuated. The child died at three years of age. In the notes upon this obſervation he tells us its body was not opened after its death.

This hiſtory is built only upon the parent's information, whoſe intereſt it was to make the caſe wonderful, and therefore not to be relied on. There is not any mention of ſecundines, to know whether the umbilical rope was hanging at them; and the breadth of the ſpot anſwers very well to the navel, which probably would have been made certain by a diſſection.

The ſecond caſe of a navel being wanting is told in a letter of an anonymous author (a), who relates that the belly of a hare being opened, three conſiderable balls tumbled out, in each of which was a little hare covered all over with fur, and that upon the moſt careful examination, he could not perceive any communication betwixt the fœtus and the dam.

But the account which this author gives ſeems to be pretty full of inconſiſtencies, and as he declares himſelf never to have diſſected a hare before, he might have miſſed diſcovering the umbilical rope, ſince others accuſtomed to the diſſection of hares have done the ſame. Needham repreſents the fœtus of a rabbet with its ſecundines (which differ ſcarce any thing from thoſe of a hare) where that part of the umbilical rope in which all the veſſels are incloſed is very ſhort, and ſix inconſiderable branches go from it ſeparately to the placenta. If theſe

(a) Commer. Literar Norimberg.

veſſels were all broke at the place where they ſeparate, by the running of the dam, or in opening the membranes, the ſhort navel-ſtring would contract and be hid by the fur, ſo as to be diſcovered with difficulty, the extremities of the ſix broken veſſels would appear on the placenta like papillulæ, and the placenta would be vaſcular and whitiſh coloured, as he has deſcribed it.

If then accurate inſtances are recorded of fœtuſes being nouriſhed without any poſſibility of their receiving aliment by the mouth, or into their chylopoietic organs; and if there is no diſtinct unexceptionable proof made out, of their being ever ſupplied with nouriſhment without the navel ſtring, it neceſſarily follows that the umbilical veſſels are abſolutely neceſſary towards the nouriſhment of a fœtus and that the mouth is not ſo.

PROBLEM II.

Whether the liquor contained in the amnios is proper food for a fœtus.

THIS liquor, as ſometimes repreſented, at firſt mild and mucaginous, and afterwards thinner, more acrid and urinous, appears ill calculated for the food of the fœtus in its different ſtates: for while a fœtus is weak, and its parts have little action, they are not ſo well fitted for digeſting and breaking the coheſion of a fluid, whoſe particles ſeparate with ſuch difficulty, as when its ſtomach, guts and other chylopoietic organs are become ſtronger; conſequently this liquor ought to have been of the reverſe conſiſtence to what is above deſcribed, as we ſee happens in a caſe analogous to the preſent ſubject, that is in the conſiſtence of milk, which is at firſt thin and purgative, but afterwards becomes thicker and ſtronger food.

Needham may perhaps be ſaid to have deſcribed this liquor really to be as I have argued it ſhould have been formed; for he tells us (a), that the liquor of

(a) Obſerv. Anat. de form. fœt. cap. 3.

the amnios becomes gradually thicker than it was at firſt in the large animals: And in another place (a) he affirms, that it gradually becomes thicker, and ſoon acquires the conſiſtence of the white of an egg; nay in the laſt months of a cow's going with young, it is thicker and more viſcid than any gelly. This agrees exactly with what I alſo remarked in cows, whoſe fœtuſes with their ſecundines I have examined in a great many different ages. But neither in this view of the conſiſtence of this liquor does it appear proper nouriſhment; for though the food of a fœtus might be expected to be groſſer in the laſt months, when its organs are ſtronger than ſoon after conception, yet a liquor ſo very thick and viſcid as Needham deſcribes would be altogether indiſſoluble, and very improper for nouriſhing a creature whoſe organs of digeſtion are ſtill in a tender ſtate, and for whom nature has provided ſuch a dilute fine liquor as milk is, to ſerve for food a conſiderable time after birth, when all its parts are become much more robuſt and ſtrong. If the liquor of the amnios had been deſigned for food, it would have been at firſt a thin ſerum, which gradually came afterwards near to the conſiſtence and nature of milk; but this I never ſaw, nor do I know that any have affirmed this liquor to have been ever obſerved of ſuch a proper conſiſtence in the different times of gravidation; and therefore muſt conclude that it is not deſigned to ſerve for food.

The liquor of the amnios ſeems not only thus improper food, while it is in a natural ſtate; but there are examples of it being ſo much depraved, that it muſt have been of the worſt conſequence to the fœtus to have fed upon it. Such is the hiſtory related by Dr. Bellinger (b) of a woman who had laboured under a virulent gonorrhœa during her pregnancy, of which ſhe was cured a very little time before her delivery. The waters were very putrid and fœtid, and the membranes tender and almoſt rotten; yet the

(a) Ibid. cap. 5. (b) Tract. de fœt. nutr. cap. 9.

child was born well and healthy, which could not well have happened if this child had received ſuch putrid waters into its bowels.

The force of this objection is attempted to be taken off, by remarking that poiſons and other noxious ſubſtances do leſs harm when taken into the ſtomach than when immediately mixed with the blood. This is true if the quantities received both ways are equal; but it is of no uſe in the preſent queſtion, unleſs it is alſo proved, that ſuch a quantity of this putrid liquor as will be ſufficient to nouriſh the fœtus muſt be taken in either by the mouth or umbilical veſſels; then indeed it follows that ſuch a quantity of the putrid liquor of the amnios will do leſs harm by being received at the mouth, than if it had been conveyed by the navel. I can however ſee no reaſon to allow the minor propoſition to be true, nor am I ſenſible of being brought, by a denial of this propoſition, under a neceſſity of giving the placenta a faculty of ſeparating the pure from the impure, or of ſending the impure to the amnios, where it does no harm, and the pure to the fœtus, where it does much good. There is no neceſſity to ſuppoſe the whole maſs of the mother's blood to have been tainted with the virulence of this gonorrhœa. Poſſibly this diſeaſe had its ſeat at firſt in the vagina, and then attacked the internal os uteri, and the mucus with which it is commonly filled in the time of pregnancy (ſee an inſtance of an ulcerated os uteri from ſuch a cauſe by des Noves (a),) and this corrupted mucus might communicate its fœtor to the liquor of the amnios without the veſſels of the placenta having received one drop of it, and therefore the child might remain healthy and ſound unleſs the waters had been long enough acrid to affect the ſurface of its body; whereas had ſuch putrid liquor ſerved it for food a very ſhort time, it ſcarce could have eſcaped without ſome diſeaſe. Nay from what was ſaid concerning the ſource of the liquor of the amnios being

(a) Morgagn. Adverſ. Anat. 4, Animad. 40.

either

either the fœtus or its umbilical arteries (ſee §. 24 and 26.) it neceſſarily follows that the liquor of the amnios in this caſe could not have been corrupted in any other way than what is juſt now aſſigned, for a child could never have ſuch liquors circulate in its veſſels without being tainted.

It may be objected from what I have ſaid (§. 25.) of the branches of the umbilical vein abſorbing the liquor of the amnios, that ſuppoſing this liquor to have been corrupted in the manner I have explained it, the fœtus could not have remained ſound, becauſe the abſorbent veins muſt have taken up this corrupted ſtuff, to mix it with the blood of the fœtus. To which I anſwer, that the quantity taken up by abſorption is but ſmall, and the time would appear to have been but ſhort in which it could have been abſorbed. Next I would obſerve that though a gentle contraction is neceſſary for increaſing abſorption, yet very acrid ſubſtances irritate abſorbent veſſels to ſuch a ſtrong contraction as makes them uncapable of performing their functions, which is one principal reaſon why poiſons when ſwallowed do leſs harm than when immediately mixed with the blood; and hence the very acrid kinds of them are obſerved to produce all their bad effects on the firſt paſſages, without any appearance of their having entered the blood-veſſels (a): So the child was in much leſs danger than if the putrid liquor had been ſwallowed for food, when it would have hurt the alimentary tube, and if it had gone further muſt have tainted the whole maſs of blood; or if the lacteals had refuſed it entrance, the child would have been famiſhed; and at any rate it would have laboured under ſome diſeaſe, whereas in the hiſtory it is affirmed to have been ſound and healthy.

Whether then we conſider the liquor of the amnios in a ſound or morbid ſtate, it appears to be very ill calculated for ſerving as food to be taken into the ſtomach of a fœtus.

(a) Wepfer. de Cicut. Aquat. Mead on poiſons.

PRO-

PROBLEM III.

Whether the liquor of the amnios paſſes into the ſtomach of the fœtus.

THIS queſtion not admitting of an ocular demonſtration to decide it, ſeveral circumſtances have been brought to prove that the liquor of the amnios paſſes into the ſtomach of the fœtus; and notwithſtanding the extreme improbability that a liquor which is to ſerve as food to the fœtus ſhould previouſly be ſent into the fœtus's own veſſels to circulate and be ſecreted in order to be prepared for being ſwallowed, which §. 24 and 26. ſhew would be the caſe on this ſuppoſition; yet it has been alledged that the reſemblance between the liquor of the amnios and that of the ſtomach is a proof of the real paſſage of the liquor of the amnios into the ſtomach.

I have already deſcribed the liquor of the ſtomach as it appeared to me in fœtuſes of different animals (ſee §. 30.) but have not had opportunities to obſerve the liquor of the amnios in the different ſtates of a ſufficient variety of fœtuſes; and therefore ſhall firſt conſider it as it is repreſented by others, and afterwards ſhall ſuppoſe what I ſaw in cows to be general.

If the liquor of the amnios is at firſt mild and mucaginous, and afterwards becomes thinner and more acrid, it differs greatly from the liquor of the ſtomach, which on the contrary turns gradually more viſcous as the fœtus increaſes. (§. 30.) Nor will it ſuffice to ſay that the finer parts are abſorbed by the veſſels of the ſtomach; for ſuch an abſorption could never make a thin watery liquor leave a greater quantity of a groſs mucus than a thick gelly would do; eſpecially when there is leſs time allowed for the abſorption of the watery liquor by the quicker digeſtion which the fœtus muſt be ſuppoſed to have when it becomes larger and ſtronger. Upon which account too, the contents of the ſtomach would be more and much oftener diluted by the thin food ſwallowed in greater quantity and more

more frequently. And then we might expect ſometimes to ſee the thin liquor lately taken down, and the thick remains of the former food diſtinct, without being blended, as we obſerve the mucus of the ſtomach of adults to keep in a ſeparate body from any thin liquors drunk ſome little time before they are vomited: This however is never obſerved in the fœtus, though it has neither reſpiration, vomiting, nor other conquaſſatory preſſure on its ſtomach, to in corporate the different liquors contained in it; and therefore there is no probability that they ſhould be ſo intimately blended; ſo that on the whole the liquors of the amnios and ſtomach are ſo far from reſembling each other in this caſe, that their appearances diſcover them to be very different, and deſtroy the ſuppoſition of that of the amnios ever being ſent down into the ſtomach.

Let us next ſee how well the liquor of the amnios of cows taken for a general rule will ſerve to ſupport this alledged reſemblance. It muſt indeed be owned that till the liquor of the amnios comes to a certain degree of viſcidity, which probably happens when the cow has gone three fourths of her time, the appearances of reſemblance are pretty favourable, only while the fœtus is very young the objections to the former ſuppoſition take place, becauſe for ſome time the liquor is glairy, then becomes of the ſame conſiſtence with that in the ſtomach at the period juſt now mentioned, after which the appearances are quite deſtructive of any reſemblance; for the liquor of the amnios becomes conſiderably thicker; and even when their conſiſtence is alike, I have often ſeen the liquor of the amnios dark-brown coloured and turbid, while that in the ſtomach was of a pale watery colour, and pellucid; and at other times I have obſerved the contrary of this and other remarkable varieties of appearances: Which perſuades me that there is no communication between the cavity of the amnios and the ſtomach.

2. The liquor of the amnios is generally ſaid to be conſumed, or in very little quantity, at or near the birth; from which it is inferred that it has been ſwal-

lowed

lowed down by the fœtus. De Graaf, in confirmation of this fact, tells us (a), that he diſſected a rabbet when ſhe was about to kindle: In the time of his diſſecting the mother, ſome of the fœtuſes came out with their membranes intire, and without any liquor contained in the amnios or chorion. He obſerved alſo the ſame thing in the others which were taken out of the uterus, and to be aſſured that the coats were not broken, he diſtended the membranes with air, and found they were entire.

Whatever truth is in the general propoſition, De Graaf's obſervation ſhews only what happened in that particular animal, without determining what the quantity of liquor is for ordinary in rabbets; far leſs does it teach us what we ought to ſay of animals in general.

A great many creatures have not all this liquor conſumed at birth. I have ſeen a remarkable quantity of liquors ſtill remaining in the amnios, after the delivery of ſeveral animals, but my obſervations have not been ſufficient to determine (except in cows) what proportion the liquor of the amnios bears at birth, to what it was formerly. Harvey, who ſeems to write on this ſubject accurately and from obſervation, when he is endeavouring to prove the liquor amnii to ſerve for food to the fœtus, raiſes this objection to himſelf (b): "One might believe that the liquors which we "appointed for food to the fœtus, are excrementi-"tious, and chiefly on this account, becauſe they "increaſe as the fœtus turns bigger; and in the "birth of ſeveral creatures, when it is probable all "the aliment is conſumed, they are ſeen in great "plenty." And where he is treating of the human waters, and is proving the liquor of the amnios to be no excrement, he ſays (c) it is ſeen in leſs quantity proportionally (pro proportione) near the time of birth. In cows the liquor is evidently decreaſing in its quantity ſome months before the delivery. This

(a) De Mulier. organ. cap. 15. (b) De humor. uter.
(c) Exercit. 56.

consumption

consumption of the liquor in cows is made by its passing into the stomach of the fœtus, say the gentlemen who differ from me in opinion, but previously to this conclusion they must prove one or other of these two propositions, either that the liquor does go down into the stomach, or that it cannot possibly be carried off any other way. The truth or falshood of the first of these depends on the arguments examined in the subsequent part of this essay, and must have the same fate with them; and as to the latter proposition I flatter myself that I have demonstrated another passage by which it may go, (§. 25.) and really by which only we can suppose it to go in order to account for all the phænomena. While the fœtus is weak, the arteries of the amnios pour out more than the veins take up (§. 15 and 26), and the heat assisted by the conquassatory motions, to which the liquor is exposed, melts down its particles, and makes it appear more watery: But when the vessels of the fœtus grow stronger, and consequently the veins absorb more (§. 5.) the quantity collected does not increase so fast, and in some time the liquors thrown out and those absorbed are near equal, when the quantity of the liquor amnii remains much the same, till at last the veins prevailing, the quantity diminishes, and continues to do so till birth; but seeing the veins take up chiefly the finer particles, what they leave must become more thick and viscous. All this will, cæteris paribus, be observed in different animals proportionally to the sizes and numbers of the vessels. If what Rohault affirms (b) be true of the human liquor amnii being always in a watery state, which so far as I could observe, it is rather more than in other creatures; the arteries or exhalant vessels are smaller and the veins perform less absorption than those of brutes.

The liquor of the amnios serves to keep the fœtus and its membranes soft and extensible, hinders them from cohering, and defends the fœtus from pressure

(a) Mem. de l'Acad. des Sciences.

or

or other violence which it needs moſt to be protected from, while its parts are very tender, for which this liquor is then, at leaſt, in greater proportion than afterwards, when the fœtus is firmer and ſtronger; and by the liquors real or proportional quantity being leſs towards the time of birth, the mother is not in ſo much danger of ſuffering by the overſtretching of the uterus, as ſhe certainly would be if the waters increaſed proportionally with the fœtus.

3. Beſides theſe arguments deduced from the quality and quantity of the liquor of the amnios, it is further pleaded by thoſe who favour the opinion of the nutrition of a fœtus by the mouth, that the fœtus ſhews it was accuſtomed to take down aliment while it was in the womb, by its knowing how to ſuck as ſoon as it is born. But what is there in the leaſt analogous to a nipple within the amnios on which the fœtus could have practiſed ſucking while in the womb?

4. Here is, ſay they again, a liquor in the amnios conſtantly applied to the orifice of a canal which leads to a cavity, and wherefore it probably will paſs down there.

To this it is anſwered, that there are impediments both to the entry and paſſage of the liquor. The firſt is the lips being found generally ſhut in a fœtus. This however is denied. In moſt of the fœtuſes of cows which I looked at, the lips were contiguous; in ſome few the point of the tongue lay between them; and in all the human fœtuſes the lips were contiguous, which indeed might be expected, ſee §. 29. The force by which the lips are kept contiguous will however not probably be ſo great as that by which the eyelids are ſhut, becauſe the ſphincter oris does not ſeem to be ſo much ſuperior to its antagoniſts as the orbicularis palpebrarum is to the rectus Fallopii.

This obſtacle of the lips is not the only one; for the under-jaw being ſupported by its levators will keep the tongue applied to the roof of the mouth, and the pharynx always is ſhut, unleſs when the voluntary convulſive action of deglutition is performed. That I might

might know how these parts appeared in a fœtus, I opened the mouths of several, then cautiously depressing the point of the tongue, I saw the root of it raised up against the palate. When the root was depressed, the velum pendulum appeared hollow below where the tongue had been lodged, and was so convex above as to shut up the passages to the nostrils. As to the pharynx being always shut, it is universally known; but to make sure of it I put a funnel into the mouths of several fœtuses after their tongues were depressed, and holding them erect, I poured water into the funnel, but none passed farther than the root of the tongue.

I cannot omit the mention of the remarkable mechanism employed here, for keeping the tonuge more close to the palate, chusing the human fœtus, as best known, to illustrate it by. When a fœtus lies with its neck bended, such of the muscles as are situated below the os hyoides are considerably relaxed, which those above it are not. These latter are naturally stronger, and gaining over the others by the difference of their stretching, pull the os hyoides, tongue, &c. upwards, and press them so strongly against the upper part of the fauces and mouth, as to leave their print in the flexible parts, and by bringing all the sides of the passage into the œsophagus close together, prevent any thing's getting down into it.

Since then there are such obstacles to be overcome, the liquor of the amnios cannot pass unless either the force with which it is squeezed is superior to the resistance, or the fœtus perform the action of deglutition.

I shall now examine an experiment which is said to demonstrate the passage of the liquor of the amnios into the stomach: It is related thus by Mr. Heister (a). I received a full formed perfect fœtus of a cow, inclosed in the uterus and membranes, in cold weather; not only the liquor of the amnios which surrounds

(a) Compend. Anat. Not. 37.

the fœtus was frozen; but the ſame liquor was found frozen in the mouth, œſophagus and ſtomach like one continued ſubſtance. The column of ice in the œſophagus was about an inch thick. I ſaw the ſame phænomenon another winter.

If this column was only the water naturally contained in the gullet frozen, then all the contents of the ſtomach would run out, whenever a fœtus was ſuſpended with its head downwards, or if the gullet was ſlit open while the fœtus hanged by its mouth the water would run out as far as the ſlit; but none of theſe things happen upon trial. The icy column therefore was introduced in the gullet from the amnios or ſtomach by the expanding force of freezing liquors confined within the frozen rigid uterus and ſecundines, a force far ſuperior to any reſiſtance which can be ſuppoſed here. To confirm this I puſhed a trocar into the amnios of ſeveral calves involved in the uterus and ſecundines, and forcibly injected milk through the canula of the trocar; then cauſed the uterus to be preſſed ſtrongly by ſeveral people, ſometimes equally, at other whiles alternately, but none of it would paſs into the ſtomach, which is a demonſtration that Mr. Heiſter's experiment is not a proof of what naturally happens to a fœtus, but only of the force of expanſion in freezing liquors.

The only other ſuppoſition to be made of the fœtus taking the liquor of the amnios into its ſtomach is, that it ſwallows down theſe waters, by performing the voluntary convulſive action of deglutition. But as there is no direct proof of this, I forbear the mention of many probable arguments againſt it. Poſſibly the ſuppoſed advantage of taking in food may be alledged as an argument; but by what has been ſaid in the ſolution of the ſecond problem, and elſewhere in this paper, it appears that inſtead of an advantage, this would rather be hurtful to the fœtus; and therefore the paſſage into the ſtomach ſhould be kept cloſe ſhut inſtead of having liquor forced down into it.

5. Some

5. Some authors have asserted the necessity of such a liquor having been taken down, in order to keep the chylopoietic organs of sufficient dimensions for receiving due supplies of food after birth. If it had been considered, how languid and slow the motion of the contents of these organs must be in a fœtus, the contractile tone of whose fibres is extremely weak, and not assisted by pressure from respiration or any other power, it might have been thought, that the liquors supplied by the vessels of these hollow viscera would have been sufficient for this purpose. The youngest fœtuses have their stomachs full (§. 30.), which plainly points out the source of the liquor of the stomach to be no other than the stomach itself. The contrivance of pushing the blood in the descending aorta, with the united force of both ventricles of the heart (§. 20.) is in part designed to promote a greater secretion in these hollow viscera, where the resistance is less than in the ordinary glands.

6. The quantity of mucus in the stomach and small guts, and of the meconium in the greater (§. 30, 31.) has been brought as a convincing argument of the fœtuses feeding on the liquor of the amnios; and as a proof a posteriori a whelp brought forth without a head is mentioned (a), whose stomach was empty, and in whose intestines there was but a small quantity of excrements. It is also probable, that a circumstance in the child which Mr. Calder describes (b), may be made use of as an argument here, which having the passage from the stomach into its intestines shut up, contained but a small quantity of meconium in its guts. For it may be said, that the whelp shews the stomach not to furnish its own liquor, but to receive it from the mouth, and as well as the child had little meconium, because the liquor of the amnios was not sent down into the guts.

The quantity of matter contained in the stomach and guts of a fœtus is no argument for food being fur-

(a) De Graaf. de Mulier. organ. cap. 15. (b) Medical Essays vol. 1. art. 14.

 nished

nifhed from the amnios,but on the contrary, is a ftrong one againft it; for there is not more of the meconium after nine months, than what an infant paffes of feces in one day, and its colour evidently difcovers the liquors fecreted within the fœtus's body, to compofe a confiderable fhare of it.

If the whelp is applied to prove the ftomach incapable of furnifhing any liquor, becaufe this one was found empty, it will prove too much, fince none can fay that the ftomach fecerns no liquor. The emptinefs of the whelp's ftomach was owing to a faulty difpofition of the veffels, for I fhall foon give pofitive proof of the ftomach's being capable of furnifhing the quantity of liquor commonly found in thefe fœtufes, without receiving any thing from the amnios.

In the child, the ftomach fent nothing down, and the divided duodenum hindred the bilary and pancreatic liquors paffing freely, which made the excrements few.

The two following hiftories give pofitive evidence of the ftomach and guts being able to furnifh their contents. The firft is of a pig, which Dr. Bellinger defcribes (a) brought forth with its mouth quite fhut up, but having its ftomach and guts full of the ufual contents. The other inftance is rather ftronger; for Mr. Antoine (b) found a vifcous yellow liquor, like to excrements in the ftomach and guts of a lamb which had neither head, heart, lungs, liver nor pancreas. Hence the meconium is no other than the groffer parts of the liquors fecreted in the alimentary tube, and of the bile and pancreatic juice.

Thefe are all the arguments of any weight, which I know to be advanced for proving the paffage of the liquor of the amnios into the ftomach. In anfwer to which, I have offered reafons which feem to turn them all in favour of the fide of the queftion oppofite to that for which they were advanced; and therefore I con-

(a) De fœt. nutr. cap. 9. (b) Hift. de l'acad. des fciences, 1703.

clude

clude this third problem by afferting, that the liquor of the amnios does not pafs into the ftomach of a fœtus.

Seeing then the three problems are refolved with refpect to viviparous animals, in favour of the nutrition by the navel alone, allow me to fum up all in a fhort recapitulation of the arguments already infifted on at length.

Since the fœtus is capable of receiving its whole nourifhment by the umbilical vein alone, whereas none can fubfift without the umbilical veffels,——Since the liquor of the amnios is ill calculated, in its natural ftate, for the food of a fœtus; and becomes fometimes altogether unfit food in morbid cafes, without the fœtus being any way injured,—— Since it is highly improbable that a creature fhould furnifh its fubfiftence out of its own body, which muft be the cafe if the fœtus feeds on the liquor of the amnios,—Seeing it cannot be inferred from any refemblance of the liquors of the ftomach and amnios, nor from any other appearances, that that of the amnios is ever fent down into the ftomach, ——Seeing no direct proof can be had of the liquor of the amnios being preffed or fwallowed down; but on the contrary, all circumftances make it probable that it does not go down, and fince all the phænomena of a fœtus can be moft reafonably accounted for, without fuppofing the liquor of the amnios to be any part of its food, Is it not reafonable to exclude the mouth from the office of conveying the aliment of the fœtufes of viviparous animals, and to believe that all their nourifhment is conveyed by the umbilical veffels?

The fequel of the preceding effay on the nutrition of fœtufes; by the fame. Vol. II. art. 10.

I Come now to confider how far the nutrition of the fœtufes of oviparous animals, and of plants ferves to illuftrate or confirm what has been argued for in the prece ding effay. I fhall firft treat

Of the nutrition of the fœtufes of oviparous animals.

1. THE fhell of an egg becomes more brittle by being expofed to a dry heat.

2. The ſhell is lined every where with a very thin, but pretty tough membrane, which dividing at or very near to the obtuſe end of the egg, forms a ſmall bag in which only air is contained.

3. In a new laid egg this bag appears very little, but becomes larger when the egg is kept.

4. The white of an egg is contained in concentrical membranes, but is not all of the ſame conſiſtence; for the exterior part of it is thin and diffuſes itſelf almoſt like water, when the membranes are broke; whereas its interior part is viſcous.

5. The white of an egg can make its way through the ſhell, as appears from its waſting by keeping, eſpecially if it is expoſed to a gentle heat.

6. The globular yolk ſeems to be no other than a liquor incloſed in a membrane, becauſe whenever the membrane is broke, it runs all out; it is ſpecifically heavier than the white.

7. The chalazæ are two white ſpungy bodies, riſing very ſmall from oppoſite ſides of the membrane of the yolk, but gradually become larger as they are ſtretched out from it in an oblique direction with regard to the two ends of the egg.

8. If we compare the chalazæ to the extremities of an axis paſſing through the ſpherical yolk, this ſphere will be compoſed of two unequal portions, its axis not paſſing through its center; conſequently, ſince it is heavier than the white (§. 6.) its ſmaller portion muſt be uppermoſt in all portions of the egg.

9. The yellowiſh-white round ſpot or tread is placed on the middle of the ſmaller portion of the yolk; and therefore, by §. 8. muſt always appear on the ſuperior part of the yolk.

10. The tread ſeems to be compoſed of ſeveral circles of different colours, and in a fecundated egg contains the chick (a)

11. Eggs whoſe obtuſe ends are rubbed over with linſeed-oil, or ſuch other ſubſtances as block up ſmall

(a) Malpigh. de ovo incubat.

pores,

pores, are as fit for bringing forth chickens, when incubated by a hen, as other eggs are. Eighteen eggs, beſmeared in the manner mentioned, were marked, and ſet with the like number of other eggs, under three hens, who brought out thirty ſix chickens, not one egg of the whole number failing.

12. After incubation, the air-bag is gradually extended; till near the time of the excluſion of the chick, it occupies ſomewhat more than a third of the cavity of the ſhell.

13. The extended bag does not collapſe, upon being expoſed to the preſſure of the atmoſphere, after incubated eggs are opened (a).

14. By incubation, the white becomes thinner and more turbid, eſpecially on its upper part, near to the air-bag, where it is alſo firſt conſumed; and it is afterwards diminiſhed towards the ſharp end of the egg, till at laſt nothing of it is left, except a chalky ſubſtance at the lower part of the ſhell.

15. As the part of the white, neareſt to the tread, is waſted, its membrane and the tread ſtill approach nearer till they become contiguous. This membrane of the white is commonly called the chorion.

16. Some time before the white is quite conſumed, what remains of it is placed at the lower part of the egg, and therefore the yolk is interpoſed betwixt it and the membrane, which immediately contains the fœtus, (ſee §. 9. and 10.)

17. The white of a fecundated egg is as ſweet, and free from corruption, during all the time of incubation, as it is in a new laid egg.

(a) It is ſomewhat out of my ſphere to enquire how the additional air gets into the bag; but if any are curious enough to make this enquiry, I would recommend to them to obſerve how this air-bag diſtends and keeps ſtretched in an exhauſted receiver of an air-pump; to exhauſt the air gradually out of the ſhell, while it ſtands expoſed to the atmoſphere, both while the air-bag is entire, and after it is broke, obſerving always the riſing or falling of the mercurial gage. To conſider §. 11. and 13. and to conſult Bellini, de mot. cord. prop. ix. and Hales's Statics.

18. The thinner white generally will not coagulate with heat, till the ninth or tenth day of incubation, after which it frequently will.

19. Very ſoon after incubation, the volume of the yolk increaſes and riſes nearer to the upper part of the egg; conſequently its ſpecific weight decreaſes.

20. The yolk becomes pale and more fluid for ſome time, eſpecially on the ſide next to the chick, where its bulk alſo ſooneſt increaſes; but afterwards the membranes of the yolk turn firmer and ſtronger, and the liquor in them is leſs in quantity, and becomes more viſcous.

21. As the chick increaſes, the yolk is depreſſed in the middle, and is ſoon brought into the form of a horſe-ſhoe, in the middle of which the chick is lodged.

22. The yolk remains freſh and uncorrupted all the time of incubation, and is always coagulable.

23. Not long before the excluſion of the chick, the whole yolk is taken into its belly.

24. The whole white and yolk are not conſumed by the chick; for ſome part of the humors of the egg eſcapes through the ſhell, and is not ſupplied by any thing from without, as evidently appears from an egg's becoming ſo much ſpecifically lighter as to ſwim in water after incubation, though it ſunk in it when recent.

25. The chalazæ remain long without being conſiderably changed, unleſs they are brought nearer to each other by the creſcent form of the yolk; at laſt they degenerate into a dry chalky ſubſtance.

26. The tread is very ſoon enlarged by incubation; and being buoyed up on the top of the yolk to the ſuperior part of the egg, is placed near to the air-bag; and when both increaſe they become contiguous.

27. The tread is called amnios when it becomes large and contains the colliquamentum or liquor in which the chick is immerſed.

28. The quantity of the colliquamentum gradually increaſes till the fifteenth or ſixteenth day of incubation; on the eighteenth it is all conſumed, and in the three

three following days ſcarce any moiſture can be obſerved on the internal ſurface of the amnios.

29. The liquor of the amnios is more tranſparent than the colliquated white; its taſte is more ſalt, and it has no ſmell. Its conſiſtence at firſt is a little viſcous, then it becomes more fluid, and afterwards turns ropy again.

30. The allantois and its contained urine are to be ſeen in an egg as well as in the ſecundines of viviparous animals.

31. Though the heart is among the firſt parts of the chick which can be diſtinguiſhed, yet the umbilical veſſels are ſeen much about the ſame time.

32. The umbilical veſſels gradually diſperſe their branches upon the amnios, upon the yolk and upon the membranes of the white: The extremities of their much greater number being immerſed into the white, are extended proportionally as it is colliquated.

33. Near to the end of incubation, the umbilical veſſels begin to ſhrivel and decreaſe, till, at the excluſion, they are very ſmall.

34. The embryo is ſeen at firſt, in form of a ſmall worm; then its ſpine, with the large prominencies which afterwards ſhew themſelves to be the brains and eyes appear: The other bowels ſeem hanging from the ſpine; the chaſm of the mouth diſcovers itſelf; the extremities ſprout out; the viſcera are gradually covered with the teguments; and at laſt the beak, nails and feathers are ſeen: After which, all the parts become ſtronger and firmer, the proportional bulk of the head decreaſing.

35. After all the parts of the chick are formed, it is always found lying on its ſide, with its neck greatly bended forward, the head being covered with the upper wing, and the beak placed between the thighs.

36. When the ſhell is opened after the chick is large and ſtrong, it may be ſeen to bounce and ſpurn, ſometimes opening its mouth wide, eſpecially if it is ſtirred or pricked.

37. The mouth, gullet, and crop are always found moiſt, but never contain any quantity of liquor which can be collected or will run out in drops.

38. The bulbous glandular part of the gullet, immediately above the ſtomach, and the ſtomach, are full of a liquor, in the youngeſt chick we can diſſect, and continue full the whole time of incubation, neither infundibulum nor ſtomach having yet got the tendinous firmneſs they have in adults; nor can we obſerve the dry pellicle, which is ſo eaſily ſeparated from theſe parts in hens.

39. This liquor of the ſtomach is at firſt thin; afterwards curdy, and at laſt appears as a greyiſh white mucus, unleſs that ſome part of it frequently is coloured yellow or green by a mixture of bile; it always coagulates by boiling into a firm yellowiſh-white ſubſtance.

40. The quantity of feces was not large in the great guts of any chickens I opened before excluſion.

41. A little time before the excluſion, the chick may be frequently heard making the ſame piping ſound which hatched chickens make. In three eggs, which were all I opened in this ſtate, the beak of the chick had perforated the membrane of the air-bag.

42. The ſhell at the obtuſe end of the egg frequently appears cracked ſome time before the excluſion.

43. The chick ſometimes perforates the ſhell with its beak; but in thoſe I ſaw tumbling out of the ſhell, it was broke off irregularly, at the place where the membrane of the air-bag was joined to it.

44. After excluſion the yolk is gradually conveyed into the guts by a ſmall duct; its membranes contract themſelves, and the duct becomes ſhorter. On the tenth day after excluſion, the yolk was no larger than a ſmall pin's head, and the duct was ſcarce one twentieth part of an inch long.

From this hiſtory, I ſhall deduce the manner in which the colliquated white is taken in by the chick.

Authors generally ſeem to agree, that the fœtus of oviparous animals, while very young, receives its nouriſhment

riſhment by the navel; but ſeveral have been of opinion, that afterwards it is conveyed by the mouth. I ſhall examine the arguments uſed in proof of this; and then ſubjoin ſome negative reaſons not taken notice of.

Bellini (a) has deſcribed the tread, or ſacculus amnii, with the chalazæ firſt formed in the back of the hen, to which, according to him, the yolk is afterwards joined, and the white is acquired as they tumble down the oviduct. He ſays, the chalazæ are compoſed of numerous canals, which open into the amnios, and ſend out their roots into the cavity of the yolk, and into the white. The conſequences drawn from this deſcription, by thoſe who aſſert the nouriſhment to be carried by the mouth, are, that here are direct paſſages into the cavity, where the chick is, which can take up the liquors no other way than by the mouth.

The anſwer to this is the ſame as has been made to the other facts quoted from this author. The ſacculus amnii is not formed before the yolk; on the contrary, the yolk is evidently to be ſeen before the tread or chalazæ. Neither have the chalazæ (if they are canals) the leaſt communication with the amnios, at any time, or in any ſtate of the egg, otherwiſe than as they are both adhering to the membrane of the yolk, upon which, or within which, no particular fibres, no canals are ſtretched to the tread. If then the facts are denied, the conſequences cannot be admitted.

Harvey (b) affirms, that a liquor is found in the mouth and crop of the chick, which he concludes to be the liquor of the amnios from their reſemblance, from the quantity of the contents of the ſtomach, from the chick's being ſeen to open its mouth, and from the neceſſity creatures are in of ſwallowing, or of forcing back by vomiting whatever is introduced to the root of their tongue.

As to the reſemblance, I do not ſee how the compariſon can be made, ſeeing the liquor in the mouth

(a) De mot. cord. prop. ix. (b) De generat. animal. exercit. 58.

and

and crop is in ſuch ſmall quantity, § 37. But ſuppoſe that a ſufficient quantity was collected, the two liquors agreeing in ſeveral properties would not of itſelf be a ſufficient proof of their being the ſame; and if, for argument's ſake, the liquor in the crop was granted to be in very large quantity, and to agree in every property with that of the amnios, it would certainly appear in the ſame form for ſome time in the ſtomach, whereas it is always found very different there in the larger fœtuſes, § 39. and Harvey confeſſes as much in this place; therefore it may be concluded, that it does not get down into the ſtomach.

The quantity of the contents of the ſtomach and inteſtines may be accounted for from § 38. applied to what was ſaid on viviparous animals.

Though creatures which reſpire, are under a neceſſity of either ſwallowing, or rejecting by vomit whatever is introduced beyond their fauces, it cannot thence be concluded, that a fœtus is under the ſame neceſſity; for as it does not reſpire, it will ſuffer no inconvenience by a liquor lodging near to the glottis.

But to enforce the negative of the colliquamentum paſſing by the mouth, obſerve that this can only be ſuppoſed to happen from the fifteenth to the eighteenth day of incubation; for before the fifteenth the liquor of the amnios is increaſing, and after the eighteenth this liquor is not to be ſeen, ſee § 28. If then the liquor of the amnios were all ſwallowed in theſe days, the ſtomach ſhould be fuller at this time, its contents thinner, more pellucid, &c. like to the colliquamentum; which does not happen. Beſides, if we ſuppoſe the power of digeſtion ſo ſtrong as to expel this liquor as faſt as it is taken down in theſe three days, it would certainly follow that this powerful digeſtion, continuing in the three ſucceeding days, while there is no liquor to be ſwallowed, the ſtomach ought to be quite emptied, which it is not. And laſtly, as a more direct proof ſtill againſt Harvey, I broke the ſhells of ſeveral incubated eggs, while the colliquamentum was in large quantity; and before the amnios was opened

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I ſaw the chickens open their mouths very wide ſeveral times, but could not obſerve the quantity of liquor in which they lay any way leſſened. I afterwards carefully diſſected the chickens, and found no other than the common ſmall quantity in the crops, and the ordinary curdy mucus in the ſtomach, which ſeems a demonſtration that they do not ſwallow.

After ſuch convincing proofs, it will be needleſs to make any application of the arguments in the former part of this eſſay to this ſubject; and therefore I ſhall only deſire the readers to compare the poſture of a chick and of a hen while ſhe ſwallows liquors, that they may ſee the poſture of the chick's neck to be moſt unfavourable to the performance of deglutition, and conclude with a very ſhort hiſtory of incubation, aſſigning probable reaſons of the ſeveral appearances.

By the heat of the hen, or of ſtoves equal to it aſſiſted poſſibly by the action of the air contained in the air-bag (§ 2. 3. 12.), the white becomes thinner, eſpecially where it is moſt expoſed to theſe forces (§ 14.) and the yolk ſpecifically lighter, (§ 19) and therefore readily riſes in the white, and as by being divided into two unequal portions, by its axis the chalazæ, it preſents the ſmaller portion to the incubating heat at firſt, (§ 8. and 9.) ſo the change in conſequence of incubation being ſooneſt and greateſt here (§ 20.), and the tread being enlarged at the ſame time, the ſmaller portion of the yolk becomes of the leaſt ſpecifical weight, and therefore is buoyed up to the ſuperior part of the egg, whereby the air-bag, and membranes of the tread, become contiguous when they enlarge (§ 26), the embryo is put out of danger of being compreſſed by the yolk; and the umbilical veſſels are ſo ſituated, as to have their extremities immerſed in the liquors, which firſt undergo the proper change for being imbibed in their orifices. (§ 32.)—The incubation continuing, the white is ſtill more colliquated, and the umbilical veſſels proportionally extended, the veins to abſorb it, and the arteries to throw out any particles

particles, which are unfit for the chick, till they are farther prepared; but eſpecially to drive forward the liquors in the veins, as was explained in the account of viviparous animals (§ 20.)—When the white, in the upper part of the egg, is exhauſted, its membranes become contiguous to the amnios (§ 15.) and thereby the membranes involving the fœtus become ſufficiently ſtrong, to reſiſt the motions of the chick—The powers of incubation, aſſiſted by the pulſation and conquaſſatory motion of the umbilical veſſels, ſpread on the yolk (§ 32.), diſſolve it more, and render ſome part fine enough, to be taken up by the extremities of the umbilical vein, ſome of which penetrate its membrane; by which the liquor at laſt becomes thicker, (§ 20.) and the membrane, being in part emptied, will more eaſily yield to the weight of the chick; and is preſſed into the form of a horſhoe (§ 21.) while the net-work of veſſels extended on this membrane render it ſtronger and firmer.—The air-bag not only aſſiſts in colliquating the white; but when the humours of the egg come to occupy a leſs ſpace by the finer parts eſcaping through the ſhell (§ 24.) and by being changed into the ſolid ſubſtance of the chick, the bag enlarging (§ 12) keeps the chick and humours ſteady, and prevents their being diſordered or broke by the motions of the egg.——Branches of the umbilical veſſels being diſtributed to the amnios (§ 32.) the arteries will pour out their liquors into its cavity, in greater quantity than the veins can take up, as long as the fœtus is weak; but when the fœtus becomes ſtronger, and conſequently the abſorbent power of the veins increaſes (ſee. § 15. of the former eſſay) they will take up the fluid of the arteries faſter than the arteries pour it in, till it is quite exhauſted (§ 28 and 29)—This abſorption will go on more ſpeedily, in proportion as the progreſſive motion of the abſorbed liquor is leſs impeded, which probably is the reaſon of the colliquamentum being all taken up, between the fifteenth and eighteenth days.—By the conſtant circulation and renewal of all theſe humours of the egg, they keep freſh

fresh and uncorrupted in a fecundated egg (§ 17. and 22.) but corrupt soon in a subventaneous one; or in such whose fœtus dies in the time of incubation.—— Wherever vessels are not sufficiently filled, they contract themselves, and therefore, the white being exhausted in the last days of incubation, the umbilical vessels gradually shrivel (§ 33), which prevents the danger of an hæmorrhage, when the chick is separated from its membranes. But as the white is not sufficient at this time fully to supply the chick, the yolk is taken into its body (§ 25) and being there pressed, it is thrown gradually, by the proper trunks, (§ 23 and 44) into the guts——The vessels and glands which open into the alimentary tube, separate as much liquor as moistens it; and the stomach having no callous strong crust on its internal surface (§ 38.) separate more than in the adult; in the mean time the glands of the infundibulum pour out a liquor, which is always thicker as the chick increases, till it becomes a thick white mucus: And therefore the contents of the stomach of a fœtus in the egg must have the appearance described (§ 39.), and will be slowly passing off into the intestines. The shell at the obtuse end of the egg becoming more brittle, by being long exposed to a dry heat (§ 1.), and the membranes losing their toughness, with their moisture, the chick tears them, breaks the shell and makes its way into the common atmosphere.

The mother having no juices prepared within her, to give the chick for food after it is hatched, and its organs for taking in, and digesting aliment, being for some time too weak to supply it with nourishment, the yolk is made to supply these deficiencies, till the chick is sufficiently confirmed and strong, § 44.

Of the nourishment of plants in a fœtus state.

THE first eight numbers of the following facts are taken from Mr Geoffroy (a), and all the

(a) Mem. de l'acad. des sciences. 1711.

others,

others, except one or two obſervations of my own, are collected from Malpighius (a).

1. Flowers contain the male and female organs of generation of plants.

2. The male organs are ſmall bladders, full of a very fine duſt, each particle of which is of a particular diſtinguiſhed form in each ſpecies of plants.

3. When this duſt is ſufficiently ripe, the bladders break, with an elaſtic force, and throw it from them.

4. The female organ conſiſts of ſeveral canals which are open and wide at one extremity, but in the other, neareſt to the ſtalk of the plant, terminate in one or more cavities where ſmall roundiſh eggs are contained.

5. Both organs of generation are contained within, and protected by leaves of different make and colour in different plants.

6. Some flowers contain both the male and female organs, others only contain one or other kind.

7. Thoſe flowers which are only male or only female, either grow both from the ſame root, or the male only grow on one plant, and the female on another of the ſame ſpecies.

8. When the male duſt is prevented from having acceſs to the female organs, either the eggs do not increaſe into ſeeds, or if they grow, they are deformed, do not contain any germ or rudiment of the young plant, and are not prolific.

9. When the fecundated eggs increaſe, the germ, or young plant, of each is ſeen lodged in a pulpy ſubſtance, called the ſeminal leaves, which again adhere to and frequently are ſunk ſome way into a depreſſion of a membrane, which forms a little bag for containing a liquor, and therefore this bag is called the amnios.

10. From the ſide of this amnios, oppoſite to that where the germ, with its ſeminal leaves, is fixed, a tube (the umbilicus) goes out to be continued into the uterus.

(a) Anat. plant. cap. de ſeminum generat. & in tractat. de ſem. veget.

11. Be-

11. Before the umbilicus reaches the uterus, it paſſes through a cavity formed by another membrane which is full of liquor, or contains a great number of ſmall veſicles diſtended with liquor, and therefore is compared to the chorion.

12. The chorion and amnios become more and more turgid with liquors for ſome time, but then the liquors begin to diminiſh, the chorion being ſooneſt emptied, and the navel-ſtring ſhrivels away, till it can no longer be obſerved.

13. In the mean time the germ and ſeminal leaves increaſe apace.

14. At laſt all the liquors in the chorion and amnios are conſumed, their membranes contract and ſhrivel, the ſeed is ſufficiently large and confirmed, the ſmall peduncle, by which it adheres to the uterus, ſhrivels, turns hard and brittle, and the ſeed falls off with the leaſt force.

15. The ſeed is compoſed of its membranes, or teguments, of a large farinaceous part, and of the ſmall germ joined to the farinaceous ſubſtance, by a ſmall peduncle which is inſerted into the germ, between the plume and the ſmall root of this young plant.

16. The germ is evidently the young plant, where the plume and root may be plainly ſeen.

17. When the fecundated ſeed is ſowed, at the proper ſeaſon, the farinaceous ſubſtance ſoon becomes ſofter, and the germ ſtretches its ſtalk upwards, and its root downwards.

18. The farinaceous ſubſtance either remains under ground turning larger for ſome time, but having its ſubſtance changed more and more into a liquor, or it is extended upwards, in form of one or two pulpy juicy leaves; from theſe different forms which this farinaceous ſubſtance takes, it is called the cotyledons, ſeminal leaves or lobes.

19. After ſome time the lobes begin to ſhrivel and to have their liquors conſumed, and at laſt when their juices are all waſted, they fade away and fall off.

20. The plant grows very faſt all this time.

21. When the cotyledons are taken off before the plants are put into the earth, ſcarce any of them will vegetate and all periſh very ſoon.

22. Thoſe that grow any after, being thus deprived of their cotyledons, increaſe rather in their plume than root.

23. When the ſeminal leaves are taken away, after allowing the plant to vegetate ſo far as to come above ground, it periſhes in a little time, the roots generally decaying firſt.

24. If the cotyledons are taken away later, moſt of the plants die, and thoſe which continue to grow are always very ſmall.

25. When one cotyledon is only taken away, the plants do grow, but are not near ſo large or ſtrong as thoſe which are left intire.

26. By taking away the plume when it firſt ſprouts above ground, the roots grow very large and quickly.

To fix an analogy between animals and plants, they may be ſaid to remain in the ſtate of a fœtus, ſo long as the young creature is nouriſhed ſolely by liquors furniſhed by the uterus of the parent.

Plants therefore are only to be regarded as fœtuſes while the ſeed is ripening, before the earth, water, moiſture of the air, &c. have communicated immediately any matter for its increaſe; and in this caſe it appears moſt probable, that the umbilicus pours in liquors from the uterus and chorion into the amnios; from which they are taken up by the veſſels of the ſeminal leaves, to be conveyed partly into the fœtus, and partly into the leaves themſelves, by which the plant is increaſed, its parts unfolded, and a ſubſtance provided for nouriſhing it afterwards, when its tender roots either receive from the earth very little, or leſs than is neceſſary for the ſufficient growth of the plant.

A mixture of the mechaniſm of the viviparous and oviparous animals appears in the nouriſhment of the fœtuſes of plants; for the little plant having as in the

viviparous animals a communication with the uterus of the parent till it is fully formed, the whole quantity of the liquor it is to be nouriſhed with, is not at firſt to be ſeen, as the white is in the egg; but the uterus furniſhes the liquor to be gradually abſorbed by the cotyledons or placenta. And then on the other hand, plants reſemble the oviparous animals, ſo far as the parent being uncapable of ſupplying any juices prepared in its own body after the fœtus is ſeparated from the womb, for the nouriſhment of the plant; and the young plant not being in condition for ſome time to ſubſiſt entirely on the new nouriſhment it muſt receive, the pulpy ſeminal leaves do the ſame good office to the plant, as the yolk does to the chick after it is hatched.

Since the reſemblance is ſo great between animals and plants, it would be ſuperfluous, after what has been ſaid of the former, to enter into a particular detail of the reaſons of the foregoing phænomena of plants; and it is almoſt needleſs to ſay that I would conclude both the oviparous animals and plants to favour my opinion of the whole nouriſhment of all fœtuſes being conveyed by particular abſorbent veſſels, and not by the ordinary canals through which the aliment muſt paſs, after the creature is out of its fœtus ſtate; for theſe are obvious to any who reads theſe eſſays with the leaſt attention.

Practical corollaries from the eſſay on the nutrition of the fœtuſes of viviparous animals, by the ſame. vol. 2. art. 11.

I. THE erect poſture of women, the largeneſs of the canals which open into the human uterus, and the periodical evacuations to which it is ſubject, render them more liable to abortion than the females of other creatures are; for the impregnated contents of the uterus preſs more on the orifice of the womb to force it open, the ſuperfluous quantity, evacuated pe-

 riodically

riodically at other times is apt to thruſt off the placenta (ſee §. 16.) and being poured into the cavity of the womb, either corrupts there, or opens the os uteri; both which will probably occaſion the loſs of the fœtus: Whence women much more ſeldom conceive immediately before the menſes than ſoon after. Thence alſo an appearance of blood from the uterus is a ſymptom which diſcovers great hazard of abortion.

II. To obviate theſe inconveniencies, the placenta adheres ſooner to the human womb than to the uterus of other creatures, and the fœtus has a larger proportional placenta, whereby its adheſion is ſtronger, and on both accounts the evacuation prevented.

III. When the ſuperfluous liquors are collected in the largeſt quantity, the ſtrongeſt puſh muſt be given to ſeparate the placenta from the womb; the menſes generally ſtop after pregnancy, and the child is too ſmall for ſome months to conſume them; wherefore women are moſt expoſed to abortions in the third or fourth month of their going with child.

IV. The ſtopping of the menſes occaſions faintings, nauſeas, reachings to vomit; which ſo often attack women in the firſt months of pregnancy, ſome of which help to remove and prevent other diſorders; for by the vomiting, for example, not only an evacuation is made, but leſs chyle ſent into the blood-veſſels, which therefore will have leſs of ſuperfluous liquors. Hence proper evacuations remove or mitigate ſuch ſymptoms, when they become violent and dangerous.

V. The ſeparation of the placenta from the womb muſt produce abortion, and this may be occaſioned by different cauſes operating in various manners, and requires my different treatment to prevent the loſs of the fœtus.

1. Whatever occaſions too great a quantity of blood to be ſent to the uterus, or aſſiſts, or increaſes its momentum to thruſt off the placenta; ſuch as plentiful living, compreſſure of the large veſſels, frights, violent

lent exercife; fhocks of the body, fevers, &c. will bring a woman into danger of abortion. The cure however is plainly pointed out, to wit, blood-letting, mild food in fmall quantities, and reft.

2. When the adhefion of the placenta to the womb is too weak, and the os uteri does not make a fufficient refiftance to its own dilatation, abortion may follow. Here for cure we muft rely on corroborants; and though much exercife is at firft to be fhunned, yet if the patient can by degrees be brought to bear moderate exercife, it will affift the other medicines confiderably.

3. If the finufes of the womb fuddenly collapfe for want of a fufficient quantity of fluids to diftend them, which may be occafioned by violent evacuations, &c. not only the weaknefs mentioned in numb. 2. may follow, but the veffels of the placenta which have not been proportionally emptied, will be difingaged from the excretories of the finufes by their being deprived of fufficient fpace to lodge in, and there is great danger of abortion; in fuch a cafe we are not to apply ftimulants too haftily; for fuch medicines increafe the contraction of the veffels of the uterus, and will drive off the placenta foon; but we ought to repair the quantity of the blood by balmy food, with a mixture fometimes of the leaft irritating cordials.

4. All caufes which produce a ftrong contraction of the fibres of the uterus or of the parts which can prefs upon it will indanger forcing away the placenta and opening the os uteri. Therefore fharp pains in any part of the body, and efpecially in or near to the uterus, rough emetics, fharp acrid purges, tenefmus, ftrangury, piles, and fuch like, are every day bringing on abortion. The radical cure is to remove the caufe of the pain or irri tation, by medicines adapted to its particular nature and feat. If this cannot be excuted foon enough, we muft blunt its violence and counteract its effects. The firft of thefe indications will be principally and moft fpeedily purfued in moft cafes, (except perhaps in

the inflammatory ones) by giving opiates. The ſecond intention is anſwered by diminiſhing the momentum of the blood, which venæſection effectually does, and is always uſeful in the inflammatory caſes; but is not ſo proper in ſome other circumſtances, where however the opiates generally anſwer our intentions.

VI. The liquors ſent into the fœtus by the umbilical vein not having their propelling force communicated from the mother (§. 16.) the ſtate of the mother's pulſe cannot affect the child otherwiſe than by occaſioning abortion or vitiating the fluids. Hence the impreſſions ſaid to be made on children by the imaginations of the mother cannot be accounted for phyſically. Hence alſo children may be infected with the diſeaſed juices of the mother, but eſcape catching the diſeaſes of their mothers, if either they are only topical, or if the morbid particles are ſuch as the placentary veſſels cannot abſorb.

VII. The placenta is largeſt proportionally in the youngeſt fœtuſes (§. 18.) by its being leſs capable of yielding to the ſtretching power of the contents of the uterus, than the membranous parts of the ſecundines are; and thereby it is better calculated for the greater proportional growth of the fœtus when young.

VIII. Though the ſurface of the placenta is not extended proportionally to the increaſe of the fœtus, yet the orifices of the ſinuſes keep up to that proportion (§. 5.) therefore the ſurface of contact between the uterus and placenta decreaſes, and a greater quantity of fluids is applied to it. Which may be one reaſon why the after-burthens of ripe children are brought away more eaſily than thoſe of abortions.

IX. The placenta ſeparates more eaſily after the child is born, than while it is yet contained in the uterus; for as long as the child remains there, the womb is hindered to contract; upon which, and the want of a muſcular contraction in the placenta, the ſeparation of the after-burthen depends. And ſince the degree of contraction will be proportional to the diſtraction of its muſcular fibres, we ſee another reaſon

reaſon why the after-burthens of abortions are more difficultly brought away than thoſe of ripe children; and we may obſerve how reaſonable the uſe of the powder to promote delivery (*a*) or other cordial ſtimulating medicines, is, in ſuch caſes, to haſten the contraction, when there is not ſome ſtronger contra-indication, ſuch as a fever or inflammation, to forbid their uſe.

X. The ſinuſes of the womb (§. 3.) are more ſafe and uſeful than any continued canals could have been; for theſe would have occaſioned too great an hæmorrhage when the placenta was ſeparated; whereas in the way the ſmall branches of the arteries are diſperſed upon the membranous ſides of the ſinuſes, they muſt be compreſſed as ſoon as the uterus contracts, and at the ſame time the reſiſtance which the womb occaſioned to its own returning blood by its preſſure on the large veins, being taken off when the womb collapſes, the lateral branches of the minute arteries muſt be very little diſtended with blood, and the ſinuſes very little filled. This is illuſtrated by the going away of the œdematous ſwellings of the legs in women with child, as ſoon as they are delivered. Hence immediate delivery is the only means to ſave a woman's life, whoſe placenta ſeparates before birth. And hence it is plain, why the lochia or cleanſings gradually diminiſh in quantity, and loſe their red colour.

XI. Seeing the reſiſtance to the blood in the deſcending aorta is taken off upon delivery, and that not only the placenta ſeparates with more difficulty when the womb has not contracted itſelf, but alſo a greater hæmorrhage muſt happen, it is no wonder that weak women ſhould be ſo liable to faint at this time, eſpecially if they have been kept in an erect poſture, and the midwife is too anxious to bring away the placenta ſoon. Hence ſuch ought to be delivered in a

(*a*) ℞ Boracis ſemiunciam; caſtorei, croci, ana, ſeſquidrachmam. Miſce, fiat pulvis, cui adde ol. ſtill. cinnamomi guttas octo; ſuccini guttas ſex. M.

lying poſture, the uterus allowed ſome time to contract, and the mother to have time given her to recover the fatigue of her throws, before the after-burthen is taken away. Hence alſo we may be convinced how neceſſary ſoft compreſſion with bandage is on the belly after delivery.

XII. When the quantity of the mother's blood is ſmall, or the contraction of the uterus quick, or an obſtruction happens in the arteries of the ſinuſes, the cleanſings will be ſmall. The conſtitution and pulſe readily diſcover what the want or too ſmall quantity of the lochia depend on; in the firſt ſuppoſition there is no harm from this ſtoppage, but we do miſchief if we attempt to force them; but in the other caſes we ought to encourage this evacuation by ſoft relaxing internal medicines and by injections, fotuſes, &c. applied to the womb, or near it, while other evacuations are promoted or made, if the ſymptoms become urgent.

XIII. The viſcidity of the liquor in the ſtomach may occaſion its ſticking to the guts, obſtructing the orifices of the lacteals, if not prevented by the thin, diulent, purgative milk, which flows at this time. Hence it is neceſſary to cleanſe the firſt paſſages of new born children by proper medicines, eſpecially when they are not ſuckled by their mothers, or a nurſe whoſe child is as young as themſelves.

XIV. The want of reſpiration to ſqueeze forward the bile, and the reſiſtance made to its entry into the guts of fœtuſes by the tough ſlime which lines them, make the effuſion of their bile ſlow; and therefore their gall-bladder is generally full of a green ſharp bile. Hence at birth, or ſoon after it, children often have the jaundice, the thick ſlime producing the ſame effects in them, as ſtones in the biliary duct. This diſorder (a) generally yields to gentle purges, and is often carried away by any medicine which increaſes the contraction of the guts. It is alſo from this collection of bile during geſtation, that children are frequently

(a) See,

ſubject

ſubject to gripes, and green purging ſoon after birth, which cleanſes their guts of ſlime and meconium, and diſcharges that ſharp bile which, if not removed, might bring on worſe diſorders.

XV. From the care with which providence not only ſupplies a ſufficient quantity of nouriſhing juices to the fœtuſes of animals and plants, but alſo furniſhes ſubſtances prepared by the mother's organs, for ſerving them after they are ſeparated from her, viz. Milk in the viviparous, the yolk in the oviparous animals, and the farinaceous ſubſtance of the ſeeds in plants; and from what we obſerve of brutes, which only by degrees come to uſe the common food of their parents, we may be convinced, that milk is the moſt proper aliment for infants; that a ſudden change of food is dangerous to ſuch tender creatures, and that therefore when children are to be weaned from the breaſt, it ought to be taken only by degrees from them, and their food ought to be ſuch as is neareſt to milk. By this method I have often prevented all the troubleſome diſorders which generally attend weaning.

XVI. From what was remarked above (§. IV.) of the diſorders which women are ſubject to, when their menſtrua are about to flow, we may rationally conclude, that a nurſe, who has ſuch a redundancy of ſuperfluous liquors, will have her milk changed to the worſe. And from what all practiſers in phyſic have obſerved, of the effects of deriving a more than ordinary quantity of juices to one part, in order to make a revulſion from another, we have reaſon to think, that a nurſe whoſe menſes are brought on by any other cauſe than a ſuperfluity of liquors, will come not only to have leſs, but alſo worſe milk, after ſuch an evacuation. If particular circumſtances oblige us to continue a child with ſuch a nurſe, the child ought to be kept up from the breaſt, either before the evacuation in the firſt ſuppoſition, or for ſome time after, when it has been brought on by any other cauſe.

A demonſtration of the ſtrength of bones to reſiſt powers applied to break them tranſverſely, by Dr. WILLIAM PORTERFIELD, *Fellow of the Royal College of Phyſicians in Edinburgh.* Vol. I. art. 10.

LEMMA.

THE ſum of the actions of two or more agents conſpiring to act in parallel lines, is always as the ſum of their abſolute forces, multiplied into the velocity of their common center of gravity.

DEMONSTRATION.

Let A, B, (Tab. I. Fig. 8.) repreſent the abſolute Force of the agents A and B, whoſe common center of gravity is C, and let the parallel lines A *a*, B *b*, C *c*, repreſent the velocities and directions of the agent A, the agent B, and their common center of gravity C reſpectively: The action of agents being always as rectangles, under their abſolute forces and velocities; the action of A, ſhall be $A \times Aa$, the action of B, $B \times Bb$; the ſum of their actions $A \times Aa + B \times Bb$, and the ſum of their abſolute forces multiplied into the velocity of their common center of gravity, $A \times Cc + B \times Cc$. I ſay, $A \times Aa + B \times Bb = A \times Cc + B \times Cc$.

Caſe 1. If the velocities A *a* and B *b* are equal, they will alſo be equal to C *c*; if therefore C *c* be ſubſtituted in place of A *a* and B *b*, the ſum of the actions ſhall be $A \times Cc + B \times Cc$; but this alſo is the ſum of the abſolute forces multiplied into the velocity of their common center of gravity, and therefore they are equal.

Caſe 2. If the velocities are unequal, let A *a* be leſs than B *b*, draw the line *a e*, parallel to A B, cutting C *c* in *f*; A *a*, C *f*, B *e* ſhall be equal, which call *v*.

Let

Let $fc = x$, and $eb = z$, hence Cc ſhall be $= v + x$, and $Bb = v + z$: The ſum of the actions ſhall be $Av + Bv + Bz$, and the ſum of the abſolute Forces multiplied into the velocity of their common center of Gravity ſhall be $Av + Bv + Ax + Bx$; which two laſt we contend are equal.

From the definition of the center of gravity $ac : cb :: B : A$, and by compoſition $ac : ac + cb$, that is, $ab :: B : B + A$; but (becauſe of the ſimilar triangles afc, aeb) $x : z :: ac : ab$; therefore $x : z :: B : B + A$, hence $Bz = Ax + Bx$; and therefore $Av + Bv + Bz = Av + Bv + Ax + Bx$, that is, the ſum of the actions of the agents A and B is equal to the ſum of their abſolute forces, multiplied into the velocity of their common center of gravity.

Caſe 3. If the number of agents be greater than two; let them be ſuppoſed three. By Caſe 1. and 2. the ſum of the actions of two of them is equal to what would ariſe, did both coaleſce in one, and move with the velocity of their common center of gravity. Hence the number of agents are reduced to two, and conſequently fall under what has been above demonſtrated. By the ſame way of proceeding, 3, 4, 5, or any given number of agents, may, (without altering their joint force or Action) be ſuppoſed to coaleſce and move with the velocity of their common center of gravity; and therefore, univerſally, the ſum of the actions of any number of agents, conſpiring to act in parallel lines, is always as the ſum of their abſolute forces, multiplied into the velocity of their common center of gravity.

COROLLARY.

Action and reaction being equal, it follows that the total reſiſtance of any number of powers reſiſting in parallel directions is always as the ſum of their abſolute reſiſting forces multiplied into the velocity of their common center of gravity.

THEOREM.

THEOREM.

The ſtrength of bones, that is the force whereby they reſiſt being broken tranſverſely, is as the area of their tranſverſe ſection, multiplied into the diſtance of its center of gravity, from the center of revolution on which the bone is ſuppoſed to be broken.

DEMONSTRATION.

The abſolute force whereby bones reſiſt being broken tranſverſely, is the power of coheſion uniformly diffuſed over the whole cohering ſurface: And this power of coheſion is compounded of all the powers exerted in every point of that ſurface: But theſe powers reſiſt in parallel directions (being all perpendicular to the tranſverſe ſection of the bone,) with velocities proportional to their diſtance, from their centers of revolution: And therefore, (by preceding Cor.) the ſtrength of the bone, or total reſiſtance of all theſe powers ſhall be as their ſum multiplied into the velocity of their common center of gravity, that is, as the area of the tranſverſe ſection of the bone, multiplied into the diſtance of its center of gravity, from the center of revolution.

COR. 1.

In comparing the ſtrength of bones, if the areas of their tranſverſe ſections are to one another reciprocally as the diſtances of the centers of gravity of thoſe ſections, from their centers of revolution, the bones will be of equal ſtrength; and contrarily, if the bones are of equal ſtrength, the areas of their tranſverſe ſections, and the diſtances of the centers of gravity, from the centers of revolution, will be reciprocally proportional.

COR. 2.

In comparing the ſtrength of bones: If the areas of their tranſverſe ſections are equal, their ſtrength will be as the diſtances of the centers of gravity from their centers

centers of revolution; and if thoſe diſtances are equal, their ſtrength will be as the areas of their tranſverſe ſections.

COR. 3.

Since the center of circles coincides with their center of gravity, the ſtrength of bones, whoſe tranſverſe ſections are circles, will be as the areas of thoſe ſections and their radii jointly.

COR. 4.

The diameters and peripheries of circles being as their radii, their ſtrength ſhall alſo be as the areas of their tranſverſe ſections and peripheries, and as the ſame areas and diameters, jointly.

COR. 5.

Circles being to one another as the ſquares of their diameters, and conſequently as the ſquares of their radii and peripheries; it follows, that in ſolid bones, whoſe tranſverſe ſections are circles, their ſtrength is as the cubes of their diameters, of their radii, and of their peripheries.

COR. 6.

Similar figures being to one another as the ſquares of their homologous ſides; the ſtrength of bones, whether ſolid or hollow, whoſe tranſverſe ſections are ſimilar, muſt be as the ſquares of the homologous ſides of theſe ſections, and the diſtances of their centers of gravity from the centers of revolution jointly.

SCHOLIUM.

In hollow bones whoſe tranſverſe ſections are ſimilar, their ſtrength muſt alſo be as the ſquares of their thickneſs, taken at ſimilar points of their tranſverſe ſections, and the diſtances of their centers of gravity from the centers of revolution jointly.

For the lines Cx, cx. Hz, hz, &c. (See tab. 1. fig. 9. and 10.) meaſuring their thickneſs at ſimilar points

points become homologous ſides of the reſpective ſections, which are here to be conſidered as figures returning into themſelves at theſe lines C x, $c\,x$. H z, $h\,z$. &c.

COR. 7.

The ſtrength of bones, whoſe tranſverſe ſections are ſimilar, muſt alſo be as the ſquares of the perimeters of their tranſverſe ſections, and the diſtances of their centers of gravity from their centers of revolution jointly.

For (ſee tab. 1. fig. 9 and 10. 11 and 12.) if the areas of their tranſverſe ſections are called Z^2, z^2. and the diſtances of their centers of gravity from their centers of revolution are called D, d. $Z^2 : z^2 :: AB\text{q} : ab\text{q} :: BC\text{q} : bc\text{q} :: CD\text{q} : cd\text{q} :: DE\text{q} : de\text{q} :: EA\text{q} : ea\text{q}$. Hence $Z : z :: AB : ab :: BC : bc :: CD : cd :: DE : de :: EA : ea :: AB + BC + CD + DE + EA : ab + bc + cd + de + ea$ therefore $Z^2 : z^2 :: \overline{AB + BC + CD + DE + EA}\text{q} :: \overline{ab + bc + cd + de + ea}\text{q}$; but the ſtrength of bones has been demonſtrated to be as $Z^2 : z^2 +$ as $D : d$, and conſequently their ſtrength muſt alſo be as $\overline{AB + BC + CD + DE + EA}\text{q} : \overline{ab + bc + cd + de + ea}\text{q} +$ as $D : d$.

SCHOLIUM.

From the like way of reaſoning it follows, that in hollow bones their ſtrength will alſo be as the ſquares of the perimeters of their cavity meaſured on their tranſverſe ſections.

For (fig. 9, 10.) the lines HI & hi. IF & if. FG & gf. GH & gh. may be conceived as homologous ſides of the reſpective ſections, which muſt here be conſidered as figures recurring on themſelves in the lines H z, $h\,z$.

COR. 8.

In comparing the ſtrength of bones whoſe tranſverſe ſections are ſimilar, if right lines are drawn from the centers of gravity of theſe ſections to ſimilar points of their

their perimeters, (which we ſhall call ſimilar radii of gravity) their ſtrength ſhall be as the ſquares of theſe ſimilar radii, and the diſtances of the centers of gravity of their tranſverſe ſections from their centers of revolution jointly.

For in the figures O B C D E A B O, *obcdeabo* (ſee fig. 9 and 10. 11 and 12.) the lines O b, *ob*, &c. drawn from their centers of gravity O, *o*, to ſimilar points B, *b*, &c. may be conceived as homologous ſides of the reſpective figures, which in this caſe are to be conſidered as figures returning into themſelves at the lines O B, *ob*, &c.

COR. 9.

If the right lines BO, *bo*, (fig. 9 and 10, 11 and 12.) are produced to ſimilar points K and *k*, their ſtrength will alſo be as the ſquares of theſe lines thus produced, that is, as the ſquares of the diameters of gravity of the tranſverſe ſections, and the diſtances of the centers of gravity of the ſame ſections from their centers of revolution jointly.

This is demonſtrated as Cor. 7.

COR. 10.

The ſtrength of bones, whoſe tranſverſe ſections are ſimilar, being by Cor. 8. as the ſquares of the ſimilar radii of gravity of theſe ſections, and the diſtances of their centers of gravity from their centers of revolution jointly, it follows, that when they are to be broken ſimilarly, or, in other words, when the fulcrum or center of revolution is placed in ſimilar points of the bones, their ſtrength ſhall be as the cubes of the ſimilar radii of gravity of their tranſverſe ſections.

For in this caſe the diſtance of the centers of gravity from the centers of revolution coincides with ſimilar radii of gravity.

COR. 11.

The homologous ſides, perimeters and ſimilar diameters of gravity of ſimilar figures being as their ſimilar

lar radii of gravity, it follows, that when bones of ſimilar tranſverſe ſections are to be broken ſimilarly, their ſtrength will alſo be as the cubes of the homologous ſides, the cubes of the perimeters, and the cubes of the ſimilar diameters of gravity, of their tranſverſe ſections.

An eſſay concerning the motions of our eyes; by WILLIAM PORTERFIELD *M. D. Fellow of the College of Phyſicians at Edinburgh.* Vol. III. art. 12.

Part I.

Of their external motions.

THE motions of the eye are either external or internal; the external are performed by the four ſtraight and two oblique muſcles, which change the ſituation of the whole globe of the eye. The internal only happen to ſome of its internal parts, ſuch as the chryſtalline and iris, or to the whole eye, when it changes its ſpherical figure, and becomes oblong or flat. The ſpherical figure of our eyes, and their looſe connexion to the edge of the orbit by the tunica conjunctiva, which is flexible and yielding, excellently diſpoſes them to be moved according to the ſituation of the object. This membrane is alſo called adnata; it takes its origin from the perioſteum all round the edge of the orbit, and is extended over the whole fore-part of the globe till it terminates in the edge of the ſclerotis, where it joins the cornea; it is covered externally with another membrane; for the internal membrane of the eye-lids, at the edge of the orbit, is turned forwards upon the outward face of the eye, and is co-extended over it with the tunica adnata, to which it adheres. Theſe two from their cloſe union, appear to be only one, and are deſcribed as ſuch under the name of membrana albuginea, though they are diſtinct membranes eaſily ſeparated; the one a continuation of

of the periosteum, lining the orbits internally, and the other of the inner membrane of the eye-lids. These membranes, especially the external, are so full of blood-vessels, and so loosely extended, that in violent ophthalmia's the white of the eye is sometimes swelled so excessively as to cover all the cornea, appearing to the unexperienced oculist as an incurable excrescence of the cornea itself. Besides these two, the fore-part of the globe is covered externally with a thin transparent aponeurosis, which not only covers the membrane which it has from the eye-lids, but likewise the cornea itself. The phlyctenæ, which are small transparent vesicles full of clear water, upon the surface of the cornea, as well as upon the white, and which even sometimes have their center in part of that circle of the cornea, where it joins the sclerotis, and occupy both a part of the white of the eye and a part of the cornea, are a convincing proof of the extension of this aponeurosis, over the whole cornea. There is a great deal of fat all round the globe, betwixt it and the orbit, which lubricates and softens the eye, and renders its motions easy. Fallopius (a) first truly described the muscles of the eye: For Galen and Vesalius erroneously ascribed the aperiens palpebram rectus to the eye, and therefore gave it seven muscles. Columbus (b) takes notice of this error, but falls into one himself, supposing that the obliquus superior belongs to the eye-lids. The first of the straight muscles is situated upon the superior part of the globe, and pulls the eye upwards, whence it is named attollens or superbus. The second is situated directly opposite to the attollens, on the under part of the eye, which it pulls down, and is therefore called deprimens or humilis. The third and fourth are towards the sides of the eye, and draw it towards the nose or from it towards the little angle. That which draws it towards the nose is called adductor or bibitorius. That

(a) Gabriel Fallop. observat. anatom. (b) Realdus Columb. de re anatom. lib. v. c. 8.

which

which pulls it from the nofe towards the little angle is called abductor or indignabundus. Thefe four mufcles arife from the hole in the bottom of the orbit, through which the optic nerves pafs; and advancing by the four cardinal parts of the eye, terminate by four broad thin tendons in the fclerotis. Thefe tendons form a large aponeurofis over the outward face of the eye under the adnata, to which it alfo adheres and terminates at the edge of the fclerotis, and there forms the cornea. Columbus pretends to be the firft difcoverer of this tunicle, to which he has given no name. Hence it is called tunica innominata Columbi, though unjuftly, becaufe it was known to Galen. Others more properly call it tunica tendinea, becaufe formed of the tendons of the four ftraight mufcles. Aquapendens is of opinion that the white of the eye has its colour from this membrane: But the conjunctiva, and the tunicle which comes from the inner membrane of the eyelids likewife concur (a). When the four ftraight mufcles of the eye act feparately, they pull the globe up or down, to or from the nofe. But when the fuperbus and adductor or abdductor act together, they perform the oblique motions attributed to the oblique mufcles; and when all four act together, they draw the eye inwards towards the bottom of the orbit, and keep it fixed in an equal fituation, which is therefore called its tonic motion.

The oblique mufcles of the eye are two in number; whereof one is called obliquus major or fuperior; the other obliquus minor or inferior. The obliquus major, fometimes called longiffimus oculi, arifes from the edge of the hole in the bottom of the orbit, which tranfmits the optic nerve, between the elevator and adductor, from whence it runs obliquely to the great canthus. In the upper part of which near the brink, there is a cartilaginous ring affixed to the os frontis, through which it paffes its tendon; from whence turning backwards, it is inferted into the tunica fclerotica, towards the

(a) Plemp. Ophthalmogr. lib. 1. cap. 5.

the back part of the bulb of the eye, in the middle between the termination of the attollens and the optic nerve. From it ſometimes the muſcle is named trochlearis: It rolls the eye about its axis towards the noſe, and at the ſame time draws it forwards, and turns its pupil downwards. The ſecond of theſe oblique muſcles is ſometimes called breviſſimus oculi. It ariſes from the lower part of the inſide of the orbit near its edge, and aſcending obliquely by the outer corner of the eye, is inſerted into the ſclerotis, betwixt the abducens and optic nerve. This muſcle rolls the eye about its axis, from the noſe, and at the ſame time draws it forwards, and directs its pupil upwards. Theſe two oblique muſcles are called circumagentes from their action in rolling the eye about. But Mr. Perrault denies any ſuch motion, becauſe he could never obſerve it in the eyes of tortoiſes; but chiefly becauſe he cannot ſee what advantage we could reap therefrom. But Mr. Mariotte (a) has demonſtrated, that the part of the bottom of our eyes, where the optic nerves enter, is inſenſible, and that the rays of light which fall thereon are entirely loſt. Now the optic nerves enter the eye a little on the inſide towards the noſe. Hence objects placed a little on the outſide of the optic axis, if not very large, would be inviſible, becauſe the rays which come from them fall upon the inſenſible part; but by the circumrotation of the eye round its axis, this part is turned aſide, and ſome of the rays of light fall upon the ſenſible part of the retina, and ſo the object, otherwiſe inviſible, at leaſt in part, becomes viſible. Many have denied this oblique inſertion of the optic nerves. Willis and Briggs tell us, that not only in man, but alſo in dogs and cats, they enter the globe at its axis, directly oppoſite to the pupil; but more accurate anatomiſts have freed us from this miſtake; and though this obliquity is leſs in man than in oxen, &c.

(a) Nouvelle decouverte touchant la vuë.

yet it is eaſy to be obſerved. Indeed ſome creatures, ſuch as the porcupine and ſea-calf, have the optic nerves inſerted into the axis of their eyes; which ſingle fact overturns Mariotte's hypotheſis of the choroides being the principal and immediate organ of ſight. Neither is it poſſible, that this defect in our ſight, where the optic nerves enter, can ariſe from the want of the choroides in this place, which according to de la Hire's reaſoning againſt Mariotte (a), ought to receive the impreſſion from the rays of light (which, according to him, paſs through the tranſparent retina without producing viſion) and communicate it to the retina, with that diſpoſition and modification which is proper for ſight, juſt as the ſpiral lamella of the ear receives the impreſſions of the air, to be communicated to the auditory nerve, for exciting in the mind the idea of ſound. For were this true, then to theſe animals, all objects would become inviſible to which their eyes are directly turned, becauſe the choroides is wanting in that place where their image falls; which is contrary to experience.

But to return. I ſhall, after what has been already ſaid of each muſcle acting apart, conſider what happens, when both act at the ſame time. When any of the ſtreight muſcles act, they will rather draw the eye inwards, within the orbit, than turn it either ſideways, or upwards, or downwards, were it not at the ſame time drawn outwards with ſome equal force. Now the above deſcribed ſituation of theſe oblique muſcles, qualifies them for keeping the globe from being retracted, when any of its ſtraight muſcles act: For by their joint contraction they muſt pull the eye outward from the bottom of the orbit, and keep it ſuſpended, as upon an axis, for the better receiving the motions of the ſtraight muſcles: And this is the principal uſe of its oblique muſcles when acting together, ſeeing they combine both in this, while they are antagoniſts to one another in their other actions. Aqua-

(a) See his diſſertation ſur les differens accidens de la vuë.

pendens

pendens (a) obſerves that in the pike the oblique muſcles decuſſate one another in form of a croſs; and Perrault (b) tells us, that they are both in the under part of the eye; and that becauſe in ſuch animals, who dive in purſuit of their prey, they have more occaſion than others to turn their eyes downwards. Cowper (c) quotes Mullinete, for deſcribing a ſeventh muſcle, which he calls the fifth right muſcle, whoſe motion he confines to the motion of the trochlea. But no ſuch muſcle is to be found in the human eye; and Mullinete might be led into this miſtake, by that part of the orbicularis palpebrarum, which adheres to the trochlea, or rather by what he might have obſerved in dogs, who have a ſmall muſcle ariſing near the origin of the obliquus major, and inſerting itſelf by a very ſlender tendon into the trochlea, to whoſe motions it is ſubſervient, as Douglas obſerves (d). Beſides theſe muſcles, quadrupeds are provided with another commonly called ſuſpenſorius, from its uſe in ſuch animals as go much with their head hanging down. Veſalius has deſcribed it as belonging to man, in whom it is never found. This muſcle ariſes from the circumference of the hole in the bottom of the orbit, through which the optic nerve paſſes, and goes directly along the optic nerve which it ſurrounds, and is inſerted into the back part of the ſclerotis all round the optic nerve, betwixt it and the termination of the ſtraight muſcles. Fiſhes and fowls commonly want this muſcle, as well as man; but oxen, and ſo far as has been obſerved, all quadrupeds, are provided therewith, though in all it is not of the ſame ſtructure, being ſometimes compoſed of two, three, or four diſtinct muſcles, as Aquapendens obſerves (e). It is the opinion of ſeveral that the only uſe of this muſcle is to draw the eye inwards, towards the bottom of the orbit, and to keep it ſuſpended, that when the eye hangs

(a) De oculo, cap. xi. (b) Du mouvement des yeux.
(c) Myotomia reformata. (d) Myographia comparata, cap. 6.
(e) De oculo. c. xi.

down, as often happens in quadrupeds, it may not fall too much out of the orbit, or by its weight fatigue the optic nerve. But this action may be in part supplied by the ſtraight muſcles acting together; and beſides, a ligament would have been ſufficient for ſuſpending the eye; and therefore it is probable that this muſcle has ſome other uſe. Dr. Tyſon finding this muſcle in the porpeſs, thinks its uſe is not to ſuſpend the bulb of the eye, but rather by its equal contraction of the ſclerotis, to which it is affixed, to render the ball more or leſs ſpherical, according to the different diſtances of objects; but it is not abſolutely certain, that the figure of the eye can be changed by the action fo this muſcle: And beſides, the neceſſary change of our eyes is well provided for by another mechaniſm. I think therefore, that the uſe of this muſcle is not only to ſuſpend the eye, and preſerve the optic nerve from being too much ſtretched, but principally to aſſiſt the ſtraight muſcles in moving the eye, according as its different fibres act. Comparative anatomy makes this opinion very probable, for in ſeveral animals it is divided into ſeveral diſtinct muſcles, whereof Aquapendens has obſerved ſometimes three, and ſometimes four in the eyes of a ſheep; and Douglas tells us that in a dog it is divided ſometimes into four, and ſometimes into five, which have as many diſtinct inſertions into the ſclerotis.

Having examined what belongs to the mechaniſm of the external motions of our eyes, I ſhall add ſome reflexions thereon. I. When nature has denied the head or eyes any motion, ſhe has with great care provided for this defect. Dr. Power's obſervations furniſh us with an example of this kind: His words are, (a) "The firſt eminent thing we found in the houſe-"ſpiders were their eyes, which in ſome were four, in "ſome ſix, and in ſome eight, according to the propor-"tion of their bulk and the length of their legs: Theſe "eyes are placed all in the fore front of their head

(a) Obſervat. 8.

"(which

" (which is round and without any neck) all diapha-
" nous and tranſparent. For ſince they wanting a
" neck, cannot move their head, it is requiſite that de-
" fect ſhould be ſupplied by the multiplicity of eyes.
" And ſince they were to live by catching ſo nimble
" a prey as a fly is, they ought to ſee her every way
" and to take her per ſaltum (as they do) without any
" motion of their head to diſcover her, which motion
" would have ſcared away ſo timorous an inſect."
To this purpoſe alſo belongs the curious mechaniſm obſervable in the immoveable eyes of flies, waſps, &c. they nearly reſemble two hemiſphers, perforated with a number of holes, each of which may be regarded as a lenticular pupil. Leeuwenhoeck's obſervations make it probable that every lens of the cornea ſupplies the place of the cryſtalline humour, which ſeems to be wanting in theſe creatures, and that each has a diſtinct branch of the optic nerve anſwering it, upon which the images are painted. So that as moſt animals are binocular, and ſpiders for the moſt part octonocular, ſo flies &c. are multocular, having in effect as many eyes as there are perforations in the cornea. By which means, as creatures with two eyes are obliged to turn their eyes to objects, ſo theſe have ſome or other of their pupils ready placed towards objects nearly all round them.
II. As in moſt creatures the eyes are ſituated in hard bony ſockets in the head, as the ſecureſt place, ſo in thoſe whoſe eyes are ſoft, nature hath endowed the creature with a faculty of withdrawing its eyes into its head. Snails are an inſtance of this, whoſe eyes are lodged in their four horns, one at the end of each horn, which they can retract at pleaſure. Perrault (a) doubts of ſnails having eyes, and Dr. Brown denies it; but a good microſcope ſhews them diſtinctly. The eyes of fiſhes, which ſeem to want contrivances of this kind, are defended by the hardneſs of the cornea. Some cruſtaceous animals have their eyes ſecured by deep ſinuſes, into which they can retract them, on the approach of any danger. Something of a mechaniſm ſimilar to this

(a) Mechanique des animeuſe.

obtains in the very little black eyes of moles, which are ſituated ſo far in the head, and covered ſo ſtrongly with hair, that they can be of no ſervice to them, unleſs they can protrude and retract them at pleaſure, as they have more or leſs occaſion to uſe or guard them.

III. We ſhall make ſome reflections on the cauſe of the uniform motion of the eyes. In ſome creatures the eyes are moved differently, the one towards one object, and the other towards another. In others the motions are uniform, and always directed to one place. The final cauſe of this uniform motion of our eyes is, 1. That the ſight may be thence rendered more ſtrong and perfect; for ſince each eye apart impreſſes the mind with an idea of the ſame object, the impreſſion will be more ſtrong and lively, when both eyes concur, than when only one, and conſequently the mind muſt receive a more ſtrong, lively and perfect idea of the object in view, as is agreeable to experience: And that both may concur, it is neceſſary they move uniformly; for though the retina be expanded upon the whole bottom of the eye, as far as the ligamentum ciliare, yet nothing is clearly ſeen but what the eye is directed to. Thus, in viewing the word MEDICINE, if the eye be directed to the firſt letter M, and keep itſelf fixed thereon, for obſerving it accurately, the other letters will not then appear diſtinctly, becauſe the ſeveral pencils of rays which come therefrom fall too obliquely to be accurately collected in ſo many diſtinct points on the retina; and chiefly becauſe of a certain degree of inſenſibility, which obtains in all parts of the retina, excepting towards the axis of the eye, directly oppoſite to the pupil. Hence to view any object diſtinctly, it is neceſſary to turn the eye directly towards it. But if the moſt ſenſible part of the retina happen, from any cauſe not to be in the optic axis, but on one ſide of it; then to ſee an object clearly, the eye muſt be directed a little to one ſide. And this may be one cauſe of ſquinting, which is eaſily incurable. Now, though only a very ſmall part of any object can at once be diſtinctly ſeen, yet

we are ſeldom ſenſible of this defect; and in viewing any large body, imagine that we ſee at the ſame time all its parts equally diſtinct and clear: But this error we are led into from the quick and almoſt continual motion of the eye, whereby it is ſucceſſively directed towards all the parts of the object, in an inſtant of time, for the ideas of objects, which we receive by ſight, do not preſently periſh, as appears from what happens when a coal of fire is nimbly whirled about, which makes the whole circumference appear like a circle of fire; and therefore if our eye takes no longer time to direct itſelf ſucceſſively to all the ſmall parts of an object, than what the coal of fire takes to go round, the mind will diſtinctly perceive all thoſe parts, without being ſenſible of any defect in any part of the retina; becauſe the idea of one part continues, till by the motion of the eye, the image of the other part be ſucceſſively received upon the ſame moſt ſenſible part of the retina. And this is the reaſon, why the globe of the eye moves ſo quickly, and that its muſcles have ſuch a quantity of nerves to perform their motions.

2. A ſecond advantage which we reap from the uniform motion of our eyes, is yet more conſiderable than the former, this conſiſts in our being thereby able to judge with more certainty of the diſtance of objects. There are ſix means which concur for judging of the diſtance of objects, of all which the moſt univerſal, and frequently the moſt ſure, is the angle which the rays of light make at the object in coming thence to our eyes: When this angle is great, we ſee the object near; when it is ſmall, we ſee it at a great diſtance; and the change which happens in the ſituation of our eyes according to the change of this angle, is a mean which our mind makes uſe of for judging of the diſtance or proximity of objects. To be perſuaded of the truth of this, ſuſpend by a thread a ring, ſo as its ſide may be towards you, and its hole look right and left, and taking a ſmall rod crooked at the end in your hand, retire from the ring two or three paces, and having with one hand covered one of your eyes, endeavour with the other to paſs the crooked end of the

rod through the ring: To do this is very difficult; the difficulty arises because when one eye is ſhut, the angle which the rays of light make at the object in coming thence to both eyes is not known, for in any triangle to know the bigneſs of an angle, it is not ſufficient to know the length of the baſe ſubtending that angle, and the magnitude of the angle which one of its ſides makes with that baſe; but it is alſo neceſſary to know the other angle, which the other ſide makes with the baſe: But this can never be known but in opening both eyes and directing them to the object, and therefore the mind can never make uſe of its natural geometry, for judging of the diſtance of the ring when one of the eyes is ſhut. From this we may ſee the uſefulneſs of two eyes placed at a certain diſtance from one another; for by uſe they get a habit of judging of the diſtance of objects by the direction of the axes, which is ſenſible to us, becauſe it depends on the motion of the eye that we feel. But creatures, that look different ways with their eyes, as fiſhes, fowls, the hare, cameleon, &c. cannot judge of the diſtance of objects from this angle. From this alſo we may ſee why we err ſo frequently in the judgments we form of the magnitude of objects ſeen only with one eye; for ſince we judge not of extenſion or magnitude from the apparent magnitude alone, but alſo from the apparent diſtance; it follows that objects ſeen with one eye muſt appear ſmaller or greater as they are imagined nearer or further off. Thus a planet viewed with a teleſcope ſometimes is judged near the eye-glaſs, and therefore appears very ſmall, while to others it appears very great, becauſe imagined a good way beyond the objective. The ſame thing happens on viewing one's ſelf in a great concave mirror not too far off; when the one eye is ſhut the face does not appear very big, becauſe it is imagined at no greater diſtance than the ſurface of the mirror; but to both eyes it appears a great deal bigger, becauſe it is then imagined much farther off. It being therefore manifeſt that the diſpoſition of our eyes, which always accompanies the angle formed of the viſual rays which

flow

flow to both pupils, and which cut one another in that point of the object on which our eyes are fixed, is one of the beſt and moſt univerſal means we have of judging of the diſtance of objects; it needs be no ſurprize that in very great diſtances, where the diſtance of our eyes bears no ſenſible proportion to the diſtance of the object, it ſhould be impoſſible for us by this or any other method to judge rightly of the diſtance, becauſe the change that happens here to this angle is ſo ſmall as to be altogether inſenſible. It is for this reaſon that we are ſo often deceived in the judgment we form of all great diſtances, and that we ſee the ſun, moon and ſtars, as if they were involved in the clouds, though they are vaſtly beyond them. And being deceived in their diſtance, we muſt alſo be deceived with reſpect to their magnitude. Thus the moon ſeems greater than the greateſt ſtar, though every body knows that ſhe is vaſtly leſs. Thus the ſun and moon appear not above a foot or two in diameter if we truſt the teſtimony of our eyes, as did Epicurus and Lucretius, who therefore imagined them no bigger than they appeared. Thus alſo the ſun and moon appear greater when near the horizon, than at a greater height, becauſe when nigh the horizon, they are judged at a greater diſtance. There is yet another advantage fully as conſiderable as any of the former, which is thought to ariſe from the uniform motion of our eyes, and that is the ſingle appearance of objects ſeen with both eyes. This indeed at firſt view appears very probable; for if in looking to any object you preſs one of your eyes aſide with your finger and alter its direction, every thing will be ſeen double. The ſame thing alſo happens when either of the eyes is from a ſpaſm or paralyſis of any of its muſcles, or from any other cauſe, reſtrained from following the motions of the other. Langius has a very remarkable caſe to this purpoſe. He tells us (in the ſeventh epiſtle of his firſt book) that in a wound of the eye it happened, through neglect, to unite and adhere to the under eye-lid; ſo that after the cure that eye was tied down, and rendered incapable of following the motions of the other: This oc-

caſioned

casioned every thing to appear double, till the eye by its frequent motions, had at last stretched the eye-lid, to which it adhered, and thereby recovered its former liberty of moving uniformly with the other. This, and multitudes of other cases, prove that when our eyes are restrained from moving uniformly, all objects are seen double. Neither is it to be doubted, but when the same phænomenon occurs in drunken or maniac persons, it proceeds from the like cause; the uniform motion of our eyes requiring an easy and regular motion of the spirits, which frequently is wanting in such cases. The same thing also happens sometimes before death, when the spirits have been worn out and exhausted. Borrichius (a) gives an example of this, in a woman who had been long ill of a disease in her breast and spleen, to whom, two days before her death, all things appeared double. He attributes this phænomenon to a change in the figure of the humours of the eye, and thinks that they had acquired the form of a polygon, which is altogether improbable. The true cause seems to have arisen from the languid irregular motion of the animal spirits, disqualifying them from directing both eyes to the same object.

Why objects seen with both eyes do not seem double, is a problem which has employed the greatest men of all ages. Galen (b) imagined it owing to the close coalition of the optic nerves behind the os sphenoides. Sir Isaac Newton accounts for it thus (c); are not the species of objects seen with both eyes united, where the optic nerves meet before they come into the brain, the fibres on the right side of both nerves uniting there, and, after union, going thence into the brain, in the nerve, which is on the right side of the head; and the fibres on the left side of both nerves, uniting in the same place, and, after union, going into the brain, in the nerve which is on the left side of the head; and these two nerves meeting in the brain in such a manner that their fibres make but one entire

(a) Act. Hafniens. vol. 2. p. 198. (b) De offic. part. lib. 10. cap. 14. (c) See the queries annexed to his optics.

species

ſpecies or picture, half of which on the right ſide of the ſenſorium, comes from the right ſide of both eyes, through the right ſide of both optic nerves, to the place where the nerves meet, and from thence on the right ſide of the head into the brain; and the other half on the left ſide of the ſenſorium comes in like manner from the left ſide of both eyes? To render this ſtill more probable he obſerves, that the optic nerves of ſuch animals as look the ſame way with both eyes, (as of men, ſheep, dogs, oxen, &c.) meet before they come into the brain; but the optic nerves of ſuch animals as do not look the ſame way with both eyes (as of fiſhes and of the cameleon) do not meet. Theſe reaſons do indeed render his hypotheſis very probable, yet there are others demonſtrative of the contrary. For although the optic nerves are united at the ſella turcica, yet this happens without any confuſion or decuſſation of their fibres: It is indeed true that their conjunction is ſo cloſe, that their ſubſtances ſeem to be confounded, yet there are ſeveral obſervations which prove that they are united only by a cloſe conjunction, without any decuſſation, interjection, mixture or confuſion of ſubſtance (a). But this is not all; for ſuppoſing our optic nerves to be united in what manner they pleaſe; yet that the ſingle appearance of objects ſeen with both eyes, does not depend on this union ſeems evident from an obſervation of Veſalius (b), who relates that objects have appeared ſingle to ſuch as had their optic nerves disjoined. Hence this phænomenon depends on ſomething elſe than the coaleſcence or decuſſation of theſe nerves; and hence it is that others have placed the cauſe of this phænomenon not in any coaleſcence, contact or croſſing of the optic nerves, but in a certain ſympathy betwixt them. To explain this ſympathy Mr. Rohault (c) ſuppoſes that in each nerve there are juſt as many fibres as in the other, and that the correſponding fibres of both nerves are united in the ſame point in

(a) See Veſal. de corp. hum. fabrica lib. 4. c. 4. Riolan. Anthropogr. l. 4. c. 2. &c. (b) Ibid. (c) Phyſic. par. 1. c. 31.

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the ſenſorium, *e. g.* ſuppoſe, as in plate IV. fig. 1. the nerves compoſed of five fibres, whoſe extremities in the right eye are A, B, C, D, E, and in the other eye *a*, *b*, *c*, *d*, *e*. The correſponding fibres A *a*, B *b*, C *c*, D *d*, and E *e*, are ſuppoſed to meet in the ſenſorium S, in the points α, β, κ, δ, ε. Hence if both eyes are directed to F, its image will fall on the retina at the optic axes, and there ſtrike the ſympathiſing fibres C and *c*; which motion being propagated to the ſingle point of the ſenſorium κ, muſt there make but one ſpecies or picture. In like manner the eyes retaining the ſame direction, the image of the point G will fall upon the right ſide of both eyes, and by ſtriking the correſpondent fibres E and *e*, will, in the ſenſorium, make but one impreſſion at ε, where theſe fibres terminate, and the image of the point H, by ſtriking the correſponding fibres A and *a*, will, in the ſenſorium, make but one impreſſion at α: And thus, though both eyes receive the ſame impreſſions from objects, yet they are not ſeen double, becauſe of theſe two impreſſions or images, one is only formed in the ſenſorium. But neither has this hypotheſis any foundation; for if, with des Cartes, we ſuppoſe the pineal gland to be the ſenſorium or chief ſeat of the ſoul, the nerves are not inſerted into it; and if, with Willis, we ſhould place the ſenſorium in the corpora ſtriata, or any other part of the brain, theſe being double and alike in both ſides, can never make one individual ſenſorium, in which all the correſponding analogous nervous fibres are united. Dr. Briggs (a) has invented another hypotheſis. He ſuppoſes, that the optic nerves conſiſt of homologous fibres, which have their riſe in the thalami nervorum opticorum, and are thence continued to both retinæ; and that theſe fibres have the ſame ſituation, diſpoſition and tenſion in both eyes; E. G. he ſuppoſes that the fibres going to the upper part of the retinæ have a greater degree of tenſion; thoſe going to the under, a ſmaller degree of tenſion; and thoſe going to the correſponding

(a) Nova Viſion. Theor.

ſides,

ſides, correſponding degrees of tenſion; and ſo forth; and conſequently, ſays he, when an image is painted on the correſponding parts of each retina, the ſame effects are produced, the ſame notice or information is carried to the thalamus, and ſo imparted to the ſoul; for the homologous and correſponding fibres of both retinæ, upon which the image falls, having the ſame degree of tenſion, may be conceived as cords of two muſical inſtruments in concord and uniſon, which from the impreſſions of light, are put into the ſame vibrations; ſo that the mind can have but one ſenſation from the ſame object, ſince the two impreſſions are re-united in one, by the ſimilar and like diſpoſition of the fibres of the two nerves, which ſo correſpond with each other, and which have ſuch a conformity and ſimilitude in their vibrations, that the ſoul cannot hinder itſelf from identifying the two impreſſions which it receives therefrom. Briggs to confirm this hypotheſis flies to experience and obſervation, pretending that this variety of tenſion in our nervous fibres, is owing to their greater or leſſer flexure in the thalami, which he ſays is manifeſt to the naked eye; and finding that the fibres on the inſide of both thalami agree in flexure, as alſo thoſe on the outſide, &c. he concludes, that they agree alſo in tenſion, and conſequently ſympathize by a ſimilitude in their vibrations. But this curious obſervation of his quite undermines his hypotheſis; for all objects a little to a ſide of the concourſe of the optic axes, would then appear double, by being painted on diſſimilar parts of the retinæ; whereas had he contented himſelf with ſuppoſing that the fibres on the inſide of one eye ſympathize with the external ones of the other, his hypotheſis had not been chargeable with this abſurdity, though even then many reaſons are not wanting for rejecting it; as 1. It is difficult to conceive how the ſoft, tender, fibres of the retina and medullary part of the optic nerves can without breaking, ſuffer that ſtrong tenſion, which ſeems neceſſary to qualify them for being put into thoſe vibrating motions, in which he makes viſion to conſiſt.

And it is more probable, that the impreſſions made upon our organs produce an undulation and refluctuation of the ſpirits, which reaching the ſenſorium, gives us the ideas of objects, than that theſe ideas ſhould be excited by theſe vibrations themſelves; and although we allow all ſenſation to proceed from the vibrations of our nervous fibres, yet this does not appear ſufficient to eſtabliſh his hypotheſis. For, 2. Suppoſing all ſenſation to proceed from vibrations excited in the nervous fibres, and that theſe fibres in the analogous and correſponding parts of the retinæ, have the ſame degree of tenſion. This is what our author ſuppoſes. Now, according to this hypotheſis, it would follow, that viſion would be more clear and ſtrong when cauſed by rays ſtriking its inferior part, where the fibres being leſs ſtretched, muſt make the vibrations more languid and faint; and conſequently an object placed below the optic axis, by painting its image upon the ſuperior part of the retina, would appear more clear and lively than when it is placed above it: But this is contrary to experience; and what we have ſaid of the ſuperior and inferior fibres, holds equally in all the reſt: For viſion being every where uniform, it is neceſſary, that the fibres by whoſe vibrations it is ſuppoſed to be occaſioned, ſhould be every where equally ſtretched. 3. If the concord, harmony and equal tenſion of the analogous and correſponding nervous fibres, were the reaſon why objects ſeen with both eyes appear not double, it is not eaſy to conjecture, why this depravation of ſight does not happen oftner than it is found to do. From all which it follows, that the cauſe of this phænomenon is to be ſought for ſomewhere elſe, than in the ſimilar ſituation, diſpoſition and tenſion of the nervous fibrillæ. The true cauſe why objects appear not double, though ſeen with both eyes, ſeems to me wholly to depend on the faculty we have of ſeeing things in the place where they are, but to explain and confirm this, I muſt premiſe the following

LEMMA.

LEMMA.

Every point of an object appears and is ſeen without the eye nearly in a ſtraight line drawn perpendicularly to the retina, from that point of it where its image falls.

That this is true we may gather from many experiments. The following is very eaſy and convincing. Suppoſe E the globe of the eye furniſhed with all its coats and humors (ſee fig. 2. and 3.) and let A be a ſmall object, ſuch as the head of a pin, whoſe diſtance from the eye muſt be greater or leſs than that at which an object would be moſt diſtinctly ſeen when viewed with the naked eye. Cloſe to the eye place a card in which is a ſmall hole made with a pin, and let Q T repreſent the card. If this hole be ſuppoſed at *x*, then the ray of light A *x* *n*, falling on the retina at *n*, will there paint the image of the ſmall object A, and make it appear in the viſual line *n* *x* A, which is perpendicular to the retina at the point *n*. But if the card be brought lower, ſo as its ſmall hole may be at *r*, the ray of light A *r*, after paſſing the hole, will be refracted in the eye ſo as to fall on the retina at ſome other point as *m*: For the object A being ſuppoſed at a greater or leſſer diſtance than that at which an object may be moſt diſtinctly ſeen with the naked eye, all its rays which paſs the pupil muſt be made to converge to a point either before or behind the retina, ſuch as *o*; but on the retina itſelf, they muſt fall on different points, according to the ſituation of the hole through which they paſs; for the eye does not change its conformation, and adapt it to the diſtance of an object viewed through a perforated card, as it always does when objects are viewed without any ſuch interpoſition. Now the object A ſeen through the hole *r* does not appear in its real place A, but at ſome other place as B, viz. in the right line *m* B, which is perpendicular to the retina at the point *m*, and if the card be raiſed, ſo as the ray A *d* may paſs the hole at *d*; after refraction, it will fall upon the retina at *i*, and

and the object will appear nearly at C, in the perpendicular *i* C. In like manner, if the card be placed with three ſmall holes, whoſe diſtance does not exceed the diameter of the pupil, as in *d*, *x*, and *r*, then the little object A will at the ſame time be ſeen in three different places C, A and B, and muſt therefore appear multiplied according to the number of holes, which proves, that the rays which flow from the object through theſe holes fall upon different points of the retina; and that there are three lines drawn perpendicularly from theſe points in the retina, in each of which the object is diſtinctly ſeen. We might here obſerve, that if the object A be brought to that preciſe diſtance from the eye, which is neceſſary for uniting all the rays in one ſingle point of the retina, as *n*, then it will appear ſingle, though viewed through ſeveral holes: And the ſame thing muſt happen, though the middle hole be covered, ſo as no rays fall upon the eye, but what paſs at the holes *d* and *r* towards the extremities of the pupil; for theſe rays being united in the retina at *n*, the object will be ſeen in the viſual line *n x* A, though no rays paſs that way. From all which it is evident that every little object or point of an object appears, and is ſeen in the viſual line drawn perpendicular to the retina, at that point of it where its image falls. Scheneir has ſeveral curious obſervations relating to this experiment (a). It is from this principle, that when a man in the dark rubs the under part or either corner of his eye with his finger, and turns his eye away from his finger, he will ſee, towards the oppoſite ſide of the eye, a circle of fiery colours, which ariſes from ſuch motions excited in the retina by the finger, as at other times are excited by light. It is likewiſe from this principle, that an object, ſeen through a priſm, appears far removed from its true place, and through a polyedrum in many places at once. The ſame principle is alſo confirmed from the erect and natural appearance of objects, though their image on the retina be inverted:

(a) Fundament. optic.

Thus (in fig. 1.) H, the lower part of the object G H is projected on *a*, the upper part of the eye, and the highest part G is projected on the lower part of the eye, which makes the image or representation *a* inverted: Yet because the point G appears without the eye in the line *e* G, and the point H in the line *a e* H, the point G must of necessity be seen higher than the point H. What hath occasioned some seeming difficulty in the business of erect appearances, is the groundless supposition that the eye, or rather the soul, by means thereof, sees an inverted image of the external object painted on the retina, and that it judges of the object from what it observes in this image: But the mind sees not any image on the retina, or takes any notice of the internal posture of the retina or the other parts of the eye, but useth them as an instrument only for the exercise of the faculty of seeing; and therefore, when the retina on its lower part, at the point *e*, receives an impulse or stroak from the rays which come from the upper part of the object G, is it not more natural, as well as useful, that the mind, without any regard to the situation of that part of the retina, should be directed to consider the stroak, as coming from the upper part of the object G, rather than from its lower part H, and consequently to conclude the cause of it, or object itself, there also? And what is said of upper and lower, holds equally in all other parts of the object. This may be illustrated by conceiving a blind man, who holding in his hands two sticks which cross each other, doth with them touch the extremities of an object placed in a perpendicular situation: It is certain, this man will judge that to be the upper part of the object which he touches with the stick held in the undermost hand, and that to be the lower part of the object which he touches with the stick in his uppermost hand.

SCHOLION.

The judgment which we form of objects being placed without the eye in those perpendicular lines, or, which

is nearly the ſame thing, the judgments we form of the ſituation and diſtance of viſual objects, depends not on cuſtom and experience, but on an organical, connate and immutable law, to which our minds have been ſubjected from the time they were firſt united to our bodies.

That the truth of this may appear, it may be requiſite we look a little into the nature of our ſenſations, and carefully obſerve what is meant in common diſcourſe, when one ſays, he ſees an object. Every body knows, that, properly ſpeaking, colours are the only proper objects of ſight. Now colours may be conſidered five ways. 1. They may be conſidered as the properties inherent in the light itſelf. Light is not ſimilar and homogeneous, but compounded of heterogeneal and diſſimilar rays, each of which are endowed with different properties; ſome, at like incidence, being more refrangible, and others leſs; and thoſe which are moſt refrangible are alſo moſt reflexible: And according as they differ in refrangibility or reflexibility, they are endowed with a power of exciting different motions or agitations in our retina; which being propagated through the nerves to the ſenſorium, give us thoſe different ideas which we call colours. So that colours conſidered as properties of light, are nothing but their diſpoſition to propagate this or that motion in the organs of viſion: Some rays, when alone, being of ſuch a magnitude, figure or ſolidity, as diſpoſes them by ſtriking the retina, to exhibit a red colour, and no other; and ſo of the reſt of the ſimple colours. But when they are mixed and blended promiſcuouſly, they exhibit compound colours of different ſorts. 2. Colours may be conſidered as qualities reſiding in the body which is ſaid to be of ſuch or ſuch a colour; and in this ſenſe, colours are nothing but the various diſpoſitions of the ſurfaces of objects, whereby they are qualified to reflect only the rays of one ſort of colour, or at leaſt in greater plenty than the other colours. 3. Colours may be conceived as the paſſion of our organs of ſight, that is the agitation

tion of the fibres of the retina by the impulſe or ſtroak received from the rays of light, which agitation is communicated to the ſenſorium. 4. Colours may be conſidered as the paſſion, ſenſation or perception of the mind itſelf, or that which all of us perceive, when we look at any object: It is this only that properly ſpeaking deſerves the name of colour; colours in objects are their diſpoſition to reflect this or that ſort of rays more copiouſly than the reſt; and in the rays of light they are their diſpoſition to excite this or that motion in the organs of viſion, and in them they are only different undulations in the animal ſpirits. In all this there is no perception, no ſenſation, no colour; for colours are ſenſations produced in our mind. The fifth manner in which colours may be conſidered, is the judgment which our mind naturally forms, when it concludes, that that which it feels or perceives, is in the body itſelf ſaid to be coloured, and not in the mind. Nothing can act or be acted upon where it is not; and therefore our mind can never perceive any thing but its own proper modifications, and the various ſtates and conditions of the ſenſorium to which it is preſent: For when I look at the ſun or moon; it is impoſſible that theſe bodies ſo far diſtant from my mind, can with any propriety be ſaid to act upon it. To imagine otherwiſe is to imagine things can act where they are not preſent; which is as abſurd as to ſuppoſe that they can be where they are not. Theſe bodies do indeed emit light, which falling upon the retina, excites certain agitations in the ſenſorium, and it is theſe agitations alone which can any way act upon the mind, and therein excite theſe modifications which we call colours; ſo that it is not the external ſun or moon which our mind perceives, but only their image impreſſed upon the ſenſorium. What we have ſaid with reſpect to colours may be alſo applied to our other ſenſations; for we not only aſcribe the colours which we perceive, to the objects we look at, but alſo we judge that our other ſenſations are in the other objects of ſenſe; thus when I taſte ſugar, I conclude it is ſweet, and

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when I ſmell camphire, I am naturally inclined to look on that ſmell which I perceive, as a quality inherent in the object; and yet it is certain that theſe different ſenſations are only the modifications of the mind itſelf. It is indeed true that our mind does not always attribute its own proper ſenſations to the external objects which produce them; for ſometimes it aſcribes them to the organs, at other times both to our organs and the objects.

The ſenſations of our mind are of three ſorts. 1ſt Strong and lively ſenſations which are thoſe that touch our mind very ſenſibly, and as it were ſurprize and rouze it up with force and vigour; and of this ſort are all thoſe ſenſations which are very agreeable or painful, and ſuch as ariſe when the organs ſuffer any thing capable of hurting or deſtroying the body; in all theſe caſes, our ſenſations are ſo briſk and lively, that the mind can ſcarce hinder itſelf from looking on them, as in ſome ſort belonging to itſelf, and therefore it does not judge that they are in the objects, but believes them to be in the members of its body, which becauſe of the ſtrict union betwixt mind and body, it conſiders as a part of itſelf. Thus when my hand is hurt, I attribute the painful ſenſation to that part of my hand on which the impreſſion is made, and not to the object producing it; and yet it is certain that pain is a ſenſation or modification of the mind itſelf, and belongs as little to our organs as colours do to objects. The ſecond ſort of ſenſations are the weak and languiſhing, in which the mind is but ſlightly touched, and which are neither very agreeable nor diſagreeable, as light when not too ſtrong, all manner of colours, taſtes and ſmells, moderate ſounds &c. Theſe ſenſations ſo ſlightly affect our mind, that it never thinks that they belong to it, or that they are in the body to which it is united, but only in the external objects which produce them; for this reaſon we rob the mind of its own proper ſenſations of light and colour, therewith to deck the object; and yet all of them are the modifications of the mind itſelf, and no ways inherent

rent in the objects in which our mind places them. The laſt ſort of our ſenſations are neither ſtrong nor faint, but of a middle nature betwixt both, ſuch as heat and cold, when moderate, great light, violent ſounds, &c. And here it may be obſerved that a weak and languiſhing ſenſation may become both a middle or ſtrong one; as for inſtance, the ſenſation of light is weak when the light of a flambeau is faint, or at a diſtance; but this ſenſation may become a middle one, if the flambeau be brought near enough to the eye for to dazzle; and likewiſe it may become very ſtrong and vivid, provided it be brought ſo near as to burn. Thus the ſenſation of light may be weak, ſtrong, or betwixt both, according to its different degrees. Now theſe middle ſenſations neither touch the mind very ſenſibly, nor very ſlightly; hence it is that is very much embarraſſed where to place its ſenſation; for upon the one hand it is inclined to follow the natural judgment of the ſenſes, in removing from itſelf, as much as poſſible, this ſort of ſenſations, to attribute them to the external objects, but, upon the other hand, it cannot altogether hinder itſelf from looking on them, as in ſome ſort belonging to itſelf; eſpecially if they approach to thoſe which we have called ſtrong and briſk; and this is the reaſon that the mind judges that cold, heat and the other middle ſenſations are not only in the ice, fire and other objects producing them, but all that part of the body itſelf upon which the impreſſions are made. Thus the mind never conſiders its ſenſations as belonging to itſelf, but attributes them either to the object, our organs, or both, according as they are of a ſluggiſh, briſk or middle nature; and though they are the modifications of the mind, yet ſince our ſenſes are not given us to inform us what things are in themſelves, but only what they are relatively to our bodies, it was neceſſary that they ſhould incline us to judge of ſenſible qualities in the manner they do; as for inſtance, it is much more profitable for us to feel pain and heat, as in our body; than that we ſhould judge them only in the objects which cauſed

 them;

them; for ſince they are capable of hurting our members, it was neceſſary that we ſhould be advertiſed when we are thereby attacked in order to ſecure ourſelves therefrom; but it is not ſo with reſpect to colours, for they do not ordinarily hurt the retina on which they fall: And it is altogether uſeleſs for us to know that they are painted there. Colours are not neceſſary unleſs to know objects more diſtinctly, and at a diſtance; and it is for this reaſon that our ſight ever inclines us to attribute them to objects. From all which it is manifeſt, that the judgments which our ſenſes induce us to make concerning the ſenſible qualities, are exceeding juſt, if conſidered with reſpect to the preſervation of our bodies, for which they were only given us; though at the ſame time, it is moſt certain that they are vaſtly removed from truth. From what has been ſaid, concerning the nature of our ſenſations, it is evident, that the mind never conſiders any of them as belonging to it ſelf, but as belonging to ſomething external. Now, ſince there is no neceſſary connexion betwixt theſe perceptions and the judgments we form concerning them, it follows, that theſe judgments muſt either depend upon cuſtom and experience, or on an original, connate and immutable law. That all of them ſhould depend on cuſtom and experience, is a contradiction in terms, it being impoſſible for us to have any experience, till we have formed a judgment, which judgment muſt therefore depend on an original, connate and immutable law, which cannot but obtain at leaſt in ſome of our ſenſations: To ſay otherwiſe, is abſurd. Hence, when the mind by cuſtom and experience, comes to conclude what it ſees to be without the eye, in ſuch perpendicular lines, this experience cannot be meant of ſight, but of ſome other ſenſe, ſuch as feeling or touch; which therefore, by a connate and immutable law, muſt, of itſelf form, a judgment of its own perceptions, and conclude, that they are not in the mind, but in ſomething external. But if, by the touch alone, we can judge thus of the ſituation and diſtance of external things, I ſee not why the ſame

power

power ſhould be denied to the ſight; nor is it more difficult for the mind to trace back the perceptions it has by ſight, from the ſenſorium to the retina, and from thence along theſe perpendicular lines to the object itſelf, than it is to trace back the perception it has by touch from the ſenſorium along the nerves to the external object occaſioning them. The ſubjecting our minds to a law in ſeeing, is as eaſy as ſubjecting them to a law in feeling. Were not the mind in ſeeing ſubjected to a law, whereby it traces back its own ſenſations from the ſenſorium to the object itſelf, and thence concludes what it perceives to be in the external object, and not in the mind, a man born blind made to ſee would at firſt have no idea of diſtance or ſituation by ſight. The remoteſt objects, as well as the nearer, would all ſeem to be in his eye, or rather in his mind; and if ſo, whence is it he comes afterwards to judge what he ſees to be in the external object? This cannot proceed from experience alone; for though by the touch we have frequently experienced the exiſtence, diſtance and ſituation of things external, and found theſe ideas to have been preceded by certain correſponding viſible ideas, I ſee not how, upon perceiving any viſible idea preſent with our mind, we ſhould judge it to be without in the external object, without ſubjecting our mind to an arbitrary irreſiſtible law directing it ſo to do. This were to eſtabliſh an eſſential and neceſſary connexion betwixt theſe judgments and the experiences we have by touch laid up in our memories; whereas no ſuch thing can be, all the connexion that is being only cuſtomary and experimental; and ſeeing nature at any rate muſt be at the charge of a law, is it not more reaſonable to ſuppoſe, that by the ſight alone, without any aſſiſtance from the other ſenſes, the mind, in conſequence of ſuch a connate and immutable law, as has been allowed it in the judgments it forms by touch, ſhould be enabled to trace back its own perceptions to the object, and thence to form a judgment of its diſtance and ſituation? I ſay is not this more reaſonable, than to ſuppoſe, that we ſtand in

need of the experiences of touch? Could these experiences be of any use without a new law, there might be some pretence for such a supposition; but this being impossible, it follows that the judgments we form of the situation and distance of visual objects depend not on custom and experience, but on an original, connate and immutable law to which our minds have been subjected from the time they were first united to our bodies. Berkely asserts that the ideas we have by sight of the distance, situation and magnitude of external things are nothing but the tactile ideas suggested to our minds. But how does this appear? When my eyes are shut, I can recall to mind the ideas of touch, which former sensation had lodged in my memory; the bare naming the thing suggests them as well as the seeing it. But every one perceives the difference between actually looking on an object, and contemplating the idea he has of it in his memory; and therefore hath certain knowledge they are not both memory or fancy. But this is not all; for though it must be acknowledged that in seeing objects, the mind, strictly speaking, perceives nothing but what is present with it, yet it does not from thence follow that the ideas of space, distance, and of the situation and magnitude of things at a distance cannot by the sight alone be introduced into our minds; for the tangible ideas are as much present with the mind as the visible ideas, and on that account must be equally incapable of introducing the idea of any thing external. When with my hand I touch an object, the idea perceived is present with my mind, and in moving my hand along the object, or in moving my body from one place to another, the ideas or perceptions which succeed one another are all of them as much present with my mind as any visible idea can be. How then can it be said that external distance and situation are only determined by the motion of the body perceivable by touch? This is to destroy the universally received notions we have of things, and to confound external space, distance and situation with a series of

ideas ſucceeding one another in the mind. It is to take away all difference betwixt ſpace and time, and to make both conſiſt in a conſciouſneſs of a ſucceſſion of different ideas or perceptions in the mind; whereas it is certain that neither of them depends on our ideas, but muſt continue the ſame whether we have any ideas or not In fine, this is not to ſolve the problem, whether it be from cuſtom and experience, or by an original connate law, that by ſight we come to judge of the ſituation of external things, but by extermina-ting all things external, to make the problem itſelf abſurd and ridiculous.

If what has been demonſtrated in the preceding lemma be duly attended to, it will not be difficult to explain how objects ſeen with both eyes appear ſingle from their being ſeen by each of them in the ſame place. For illuſtrating this let it be ſuppoſed that both eyes are directed to the point F (ſee plate iv. fig. 1.) by the preceding lemma this point muſt be ſeen by the left eye in its axis *c* F, and by the right eye in its axis C F; and ſince we have alſo a faculty of judging of the diſtance of objects, it follows, that the point F muſt be ſeen by both eyes in that preciſe place where the lines *c* F and C F interſect each other; and being ſeen in the ſame place by both eyes, it muſt neceſſarily appear ſingle, it being impoſſible for us to conceive two objects exiſting in the ſame place at the ſame time. In like manner all the other viſual points of the object G H muſt alſo appear ſingle; for ſuppoſing the eyes to continue their former directions, the rays which come from any other point, as H, will be united on the retina of the left eye on the outſide of the optic axis at *a*; and in the other eye they will be united in the inſide of its axis at A; hence the point H will be ſeen by both eyes in the lines *a* H, A H meet and interſect each other at H, and therefore ſince our mind or viſive faculty has a power of judging rightly of the diſtance of objects; it follows that the point H muſt be ſeen in both eyes in the preciſe point H; and conſequently muſt appear ſingle. What hath been juſt

now

now said of the single appearance of objects seen with both eyes, holds only with respect to objects placed in the plan of the horopter (*a*), for all objects placed out of this plane, must in consequence of the principle laid down in the foregoing lemma, be seen in two different places with relation to that point of the horopter on which our eyes are fixed; and being seen in two different places, must therefore appear double. Thus if while the optic axis (See fig. 4.) A C, B C, are directed to a mark C, for viewing it accurately, we attend to an object *x* placed any where within the angle A C B formed of the optic axes, the object *x* will appear in two places, for being seen by the right eye in the direction of the visual line B *x*, it must appear on the left side of C, and its distance from C will be measured by the angle C B *x*; and being seen by the left eye in the direction of the visual line A *x*, it must appear on the right side of C, and its distance from C will be measured by the angle C A *x*; and consequently it must appear double, and the distance between the places of its appearance will be measured by the sum of the angles C B *x*, C A *x*. The same way of reasoning applied to objects in all manner of situations, will shew that all of them must appear double when placed out of the plane of the horopter; which is exactly agreeable to experience: And this also is the reason why a double appearance will be seen, when the end of a long ruler is placed between the eye-brows, and extended directly forwards with its flat sides respecting right and left; for by directing the eyes to a remote object, the right side of the ruler seen by the right eye, will appear on the left hand, and the left side on the right

(*a*) The horopter is an imaginary line drawn through the intersection of the optic axes, parallel to a line drawn through the centers of both eyes; so that the space comprehended between these two lines forms a plane in which the two optic axes are always found. All the objects seen in this plane have a relation to the horopter or to the line which terminates it. The horopter has a good many properties in optics, which are described at large in Aguillonius opt. lib. 2. diff. 10.

hand,

hand. But we are not from this to imagine that the ſingle appearance of objects placed in the plane of the horopter ariſes from the uniform motion of our eyes; for while the left eye is directed to F (See fig. 1.) let the other be directed to G or H, it is plain from the preceding lemma, that the points G, F, and H, will continue to be ſeen in the ſame perpendicular lines EG, CF, AH, they formerly appeared in, when both eyes were directed to F; and ſince at the ſame time we have a power of judging rightly of their diſtance, it follows that here alſo they muſt appear ſingle, from their being ſeen in the ſame place by both eyes.

For the better explaining the nature of ſquinting, and from the above eſtabliſhed principles, to ſet the diagnoſtics and prognoſtics of this diſeaſe in a juſt light, it will be neceſſary to take a view of the ſeveral cauſes from which it may proceed, and to determine ſome of the chief optical effects which naturally ariſe from them, whereby the preceding doctrine will be illuſtrated and confirmed. And 1. this diſeaſe may proceed from cuſtom and habit, while in the eye itſelf, or in its muſcles, nothing is preternatural or defective. In this caſe, which may admit of a cure if not too much confirmed, objects will be ſeen in the ſame place by both eyes, and therefore muſt appear ſingle as to other men; but becauſe in the eye which ſquints, the image of the object to which the other eye is directed, falls not on the moſt ſenſible part of the retina, which is naturally in the axis of the eye, it muſt be but faintly perceived by this eye. 2. The ſtrabiſmus may proceed from a fault in the firſt conformation, by which the moſt ſenſible part of the retina is removed from its natural ſituation which is directly oppoſite to the pupil, and is placed a little to a ſide of the axis of the eye, which obliges ſuch as are troubled with this diſorder to turn the eye away from the object they would view, that its picture may fall on the moſt ſenſible part of the organ. Thus if *a* (fig. 1.) be ſuppoſed the moſt ſenſible part of the retina, in order to ſee the object H, the eye muſt be turned aſide to F. When this is the caſe, the

diſeaſe

diſeaſe is incurable, and the phænomena which ariſe therefrom differ in nothing from thoſe of the former caſe, except that here, firſt, the object to which the eye is not directed will be beſt ſeen; ſecondly, no object will appear altogether clear and diſtinct; for all objects to which the eye is directed, having their image painted on the retina at the axis of the eye, where it is not very ſenſible, will be but obſcurely ſeen; and objects which are placed ſo far to a ſide of the optic axis, as is neceſſary for making their image fall on the moſt ſenſible part of the retina muſt appear confuſed, becauſe the ſeveral pencils of rays which come therefrom, fall too obliquely on the cryſtalline to be accurately collected in ſo many diſtinct points of the retina, though this confuſion is for the moſt part ſo ſmall as to eſcape unobſerved. Thirdly, this diſeaſe may proceed from an oblique poſition of the cryſtalline, as in fig. 5. where the rays which come directly to the eye from A, and which ought to converge to the point of the retina D, which is in the axis of the eye D E, are, by reaſon of the obliquity of the cryſtalline, made to converge to another point as C, on that ſide of the viſual axis D E A, where the cryſtalline is moſt elevated, and therefore the object is but obſcurely ſeen, becauſe the image falls not on the retina at the axis of the eye, where it is moſt ſenſible. But the rays which fall obliquely on the eye, as thoſe which come from an object at B, will, after refraction, converge to the moſt ſenſible part of the retina D, and impreſs the mind with a clearer idea of the object. It is for this reaſon that the eye never moves uniformly with the other, but turns away from the object it would view, being attentive to the object to which it is not directed. When this is the caſe it is in vain to expect any good from medicine. The ſymptoms naturally ariſing from it are, 1. The object A, to which the eye is directed, will be but faintly ſeen, becauſe its image falls on the retina at C, where it is not very ſenſible. 2. The object B, to which the eye is not directed, by having its image painted on the retina at the axis of the eye

DE, will be clearly perceived. But 3. this ſame object B muſt appear ſomewhat indiſtinct, becauſe the pencils of rays which flow from it are not accurately collected in ſo many diſtinct points of the retina, by reaſon of their oblique incidence on the cryſtalline. And, fourthly, it muſt be ſeen not in its proper place B; but thence tranſlated to ſome other place A in the axis of viſion DEA (ſee the preceding lemma and ſcholium.) And fifthly, being thus tranſlated from its true place, where it is ſeen by the other eye which does not ſquint, it muſt appear double, and the diſtance between the places of its appearance will be ſtill greater if the cryſtalline of the other eye incline to the contrary ſide.

Fourthly, this diſeaſe may ariſe from an oblique poſition of the cornea, which in this caſe is commonly more arched and prominent than what it is naturally. When the eye has this conformation, no object to which it is directed can be clearly ſeen, becauſe its image falls not on the retina at the axis of the eye, and therefore the eye turns aſide from the object it would view, that its image may fall on the moſt ſenſible part of the retina.

To determine the ſituation of the eye with reſpect to the object it would view; let AGK be the axis of viſion (fig. 6.) and let the arch *b*G*d*, whoſe center is *o*, repreſent the oblique prominent cornea, and let *a*A*x* be a cone of rays having its baſis in the pupil and its apex in the moſt ſenſible part of the retina, it is evident that this cone muſt come from a point without the eye, which of all others appears moſt clear and diſtinct. To find therefore the ſituation of this point nothing is required but to trace back the middle ray AG in the line it deſcribed before its incidence on the cornea at G. For this purpoſe, erect upon the ſurface of the cornea, from the point of incidence G, the perpendicular GP, and having produced it downwards to Q, from A let fall upon it the perpendicular AD, and produce it to H, ſo that DH may be to AD as the ſine of incidence to the ſine of refraction, that is as 4 to 3, and about the center G, with the

radius

radius G A, defcribing a circle A H P, draw parallel to the perpendicular G P Q, the line H E cutting the circumference in E, and join E G; which will be the line of the incident ray, in which an object muft be placed to have its image painted on the retina at the axis of the eye A, where it is moft fenfible. For if E F be let fall perpendicularly on the line P Q, the line E F fhall be the fine of incidence of the ray E G, the angle of incidence being E G P, and this line E F is equal to D H, and confequently in proportion to the fine of refraction A D as 4 to 3. In a ftrabifmus proceeding from this caufe the prognoftic and phænomena will be much the fame as in the preceding cafe, from which neverthelefs it may be diftinguifhed by the manifeft obliquity of the cornea; and if the cornea be alfo more arched and prominent than what it is naturally, the eye will alfo be fhort-fighted.

Fifthly, this want of uniformity in the motions of our eyes may arife from a defect, or weaknefs in the fight of both or either of the eyes. This being the cafe, it follows that when the fight of both or either of the eyes is fo defective as to difappoint us of the advantages arifing from their uniform motion, the mind will not accuftom itfelf to this fort of motion, but preferve its natural liberty of moving them indifferently. An example of this may be had in thofe who from a cataract or gutta ferena have been blind from the birth in both or either of their eyes; and that the fame thing may alfo happen when the difeafe is of a later date feems evident from what Plempius (a) obferves. The prognoftic in this cafe is the fame with that of the difeafe from which it proceeds, and the phænomena are obvious from what has been faid. Sixthly, another caufe from which the ftrabifmus may proceed, lies in the mufcles which move the eye. When any of thefe are too fhort or too long, too tenfe or lax, or are feized with a fpafm or paralyfis, their equilibrium will be deftroyed, and the eye

(a) Ophthalmogr. lib. iv. probl. 13.

turned

turned towards or from that ſide where the muſcles are faulty. In this caſe the diſeaſe frequently yields to medicine, except only when by a fault in the firſt conformation any of the muſcles are longer or ſhorter than their antagoniſt. The optical phænomena are the ſame here as in the firſt caſe; only when the diſeaſe commences not till by cuſtom and habit, the uniform motion of the eyes has been rendered neceſſary, all objects for ſome time appear double. To explain this and reconcile it with what has been ſaid concerning the ſingle appearance of objects ſeen with both eyes, is a matter which deſerves to be carefully examined.

To illuſtrate this matter, let it be ſuppoſed that one wills both eyes to be directed to F (*fig.* 1.) for viewing it accurately, and that while the left eye gives ready obedience, let the other by reaſon of a recent defect in ſome of its muſcles, be turned to H, it is plain that the point F will be ſeen in the ſame perpendicular line C F it would have appeared in, had it been directed to F; but becauſe this line by reaſon of the obliquity of the eye does not fall on the retina at its axis C, but at ſome other point on the outſide of this axis as E, ſo that the angle C *o* E may be equal to the angle F *o* H, it will itſelf appear tranſlated to E G, and being thus tranſlated, the point F muſt be tranſlated with it, which therefore will be ſeen not in its proper place F, but in ſome other place as G in the perpendicular E *o* G. For ſince the mind knows not but the eye is directed to F, it muſt form the ſame judgment with reſpect to the ſituation of objects, as if it were really ſo: But it has been already ſhewn that objects are always ſeen by virtue of a connate, immutable law, in lines drawn perpendicularly to the retina, from that point of it where their image falls; and therefore the object F having its image painted on the retina at E, muſt be ſeen by this eye which the mind ſuppoſes to be directed to F, ſomewhere in the perpendicular E G, as at G; while to the other eye it appears in its true place F; and being thus ſeen in two different places G and

G and F, it muſt neceſſarily appear double. Something like this happens when an object is felt, by the extremities of two fingers which are made to croſs each other; for the mind not attending to the poſition of the fingers, judges that the object is double, becauſe felt by thoſe parts of the fingers which uſe to be at a diſtance from each other. That we have here given the true account of this phænomenon, will be further evident to any who conſiders, that when the mind does not miſtake the ſituation of the eye, as in thoſe who by cuſtom have from their infancy contracted a habit of moving their eyes differently, all objects appear ſingle as to other men: And this likewiſe is the reaſon, why, in the caſe before us, all things come in time to be ſeen ſingle. Mr. Cheſelden gives us an example of this in his ſyſtem of anatomy. A gentleman who from a blow in the head had one eye diſtorted, found every object appear double; but by degrees the moſt familiar ones became ſingle; and in time all objects became ſo, without any amendment of the diſtortion. From all that has been ſaid we may deduce this inference; The double appearance of objects which happens when either of the eyes is reſtrained from following the motions of the other, does not prove that to ſee objects ſingle it is abſolutely requiſite that both eyes be directed to the ſame object, and that this is one of the final cauſes of their uniform motion. Laſtly, this want of uniformity in the motions of our eyes may proceed from a preternatural adheſion to the eye-lids: And the ſame thing may alſo be occaſioned by a tumor of any kind within the orbit, preſſing the eye aſide, and reſtraining it from following the motions of the other. Here alſo the caſe may admit of a favourable prognoſtic; and the optical phænomena muſt be the ſame as in the preceding caſe.

Having finiſhed what I intended to ſay, concerning the final cauſes of the uniform motions of our eyes, I come now to enquire into the efficient cauſe of this uniformity. Moſt of the ancients attribute this to the union of the optic nerves near the ſella oſſis ſphenoidis; but

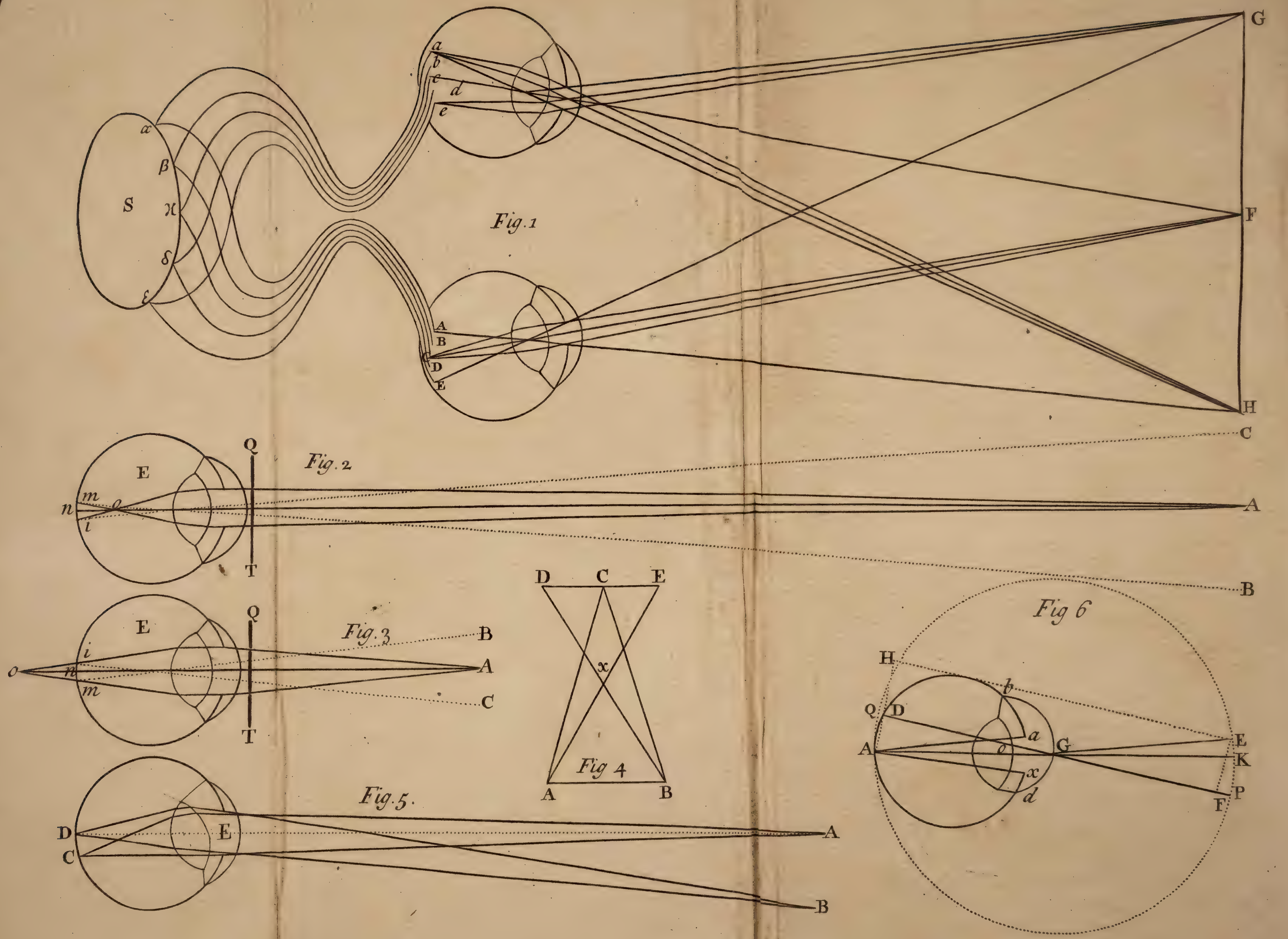

Fig. 1
S
α β κ δ ε
a b c d e
A B C D E
G F H
Fig. 2
E
Q T
n m o i
C A B
Fig. 3
E
Q T
o n i m
B A C
Fig. 4
D C E
x
A B
Fig. 5.
D C E
A B
Fig 6
H b Q D a A o G x d
E K P F

but ſince theſe nerves give no branches to the muſcles, but are wholly beſtowed upon the retinæ, it follows, that they can contribute nothing toward the motion of our eyes, but ſerve only to convey to the mind the impreſſions made on their fund by the rays of light. Hence it is that in blindneſs from obſtructions in thoſe nerves the eyes continue to move as formerly, becauſe their motion does not depend upon the optic nerves, but upon their other nerves and muſcles. But ſuppoſing that the optic nerves did contribute to the motion of our eyes, yet their conjunction could never occaſion this uniform motion, becauſe, as Diemerbroek obſerves (a), anatomiſts have found them disjoined in ſome ſubjects, who, while alive, moved their eyes as other men. The moderns have with good reaſon rejected this hypotheſis; but have not themſelves ſucceeded better, when they tell us, that this happens becauſe the nerves beſtowed upon the muſcles of our eyes, called oculorum motorii, are united at their origin in the brain. Our fingers are at liberty to execute different motions, and to be extended ſeparately, though not only the nerve, but alſo the muſcle, ſubſervient to their extenſion, is but one: Whence therefore this liberty ſhould be denied our eyes, whoſe muſcles are diſtinct, I ſee not. But this is not all; for there are many parts of the body, which, though they have nerves of different origins, yet neceſſarily move together. Thus the eyes cannot be turned up or down, but the eye-lids follow their motion, and keep at the ſame diſtance from the pupil, though at the ſame time the eye-lids can be moved without any motion in our eyes. Did this uniform motion depend upon any union or conjunction of the oculorum motorii, or any other of the nerves, none would ſquint but ſuch as had them disjoined. The true cauſe of this uniformity in the motions of our eyes ſeems wholly to depend on cuſtom and habit. For theſe motions are voluntary and depend upon our mind,

(a) Anat. lib. iii. cap. 16.

which being a wiſe agent, wills them to move uniformly, not from any intrinſical neceſſity in the thing itſelf, or for want of a power to move them differently, but becauſe ſuch motions are moſt uſeful to us. As for other creatures who move their eyes differently, ſuch as the cameleon, which has this faculty in an eminent manner, ſo that the one eye is moved whilſt the other remains unmoved; it is evident, ſince the organs ſubſervient to thoſe motions, are the ſame as in man, that it is the utility and advantage they receive from theſe particular motions which determines that principle which governs and rules all their motions to actuate the organs in ſuch a manner as thoſe motions, which they find moſt profitable and neceſſary for them, may follow. And as the hare, cameleon, &c. have a power of moving their eyes differently, ſo without doubt, at firſt we ourſelves are alſo poſſeſſed of the like power; children for ſome time after birth, can look different ways with their eyes; which power they retain till by diſcovering the advantage of directing them the ſame way, they come to move them always uniformly; this uniform motion by uſe and habit at laſt becomes ſo neceſſary, that the eyes cannot be moved differently; long cuſtom rendering many actions neceſſary, which were not ſo eſſentially, or from the beginning.

PART II.

Of the internal motions of the eyes. Vol. iv. art. 14.

THE internal motions of our eyes are either ſuch as reſpect the change of conformation, which is neceſſary for ſeeing diſtinctly at different diſtances, or ſuch as only reſpect the dilatation and contraction of the pupil. That our eyes change their conformation, and accommodate themſelves to the various diſtances of objects, is obvious from the phænomena of viſion. It has been demonſtrated, that when a man views any object

object, the light, which comes from its ſeveral points, is ſo refracted by the tranſparent ſkins and humours of the eye as to converge and meet again at ſo many points in the bottom of the eye, and there to paint the picture of the object on the retina; which picture being propagated by motion along the fibres of the optic nerves, into the brain, is the cauſe of viſion; for according as theſe pictures are perfect or imperfect, the object is ſeen perfectly or imperfectly. We have an example of this in the eyes of old men, whoſe humours are ſo much waſted and decayed, that through a penury thereof, the cornea becomes leſs convex, and the cryſtalline grows flatter; by which means the light, for want of ſufficient refraction, does not converge to a point in the bottom of the eye, but at ſome place beyond it; and, by conſequence, paints in the bottom of the eye a confuſed picture; and according to the greater or leſs confuſion of this picture, in the more or leſs flat eyes, the object appears more or leſs confuſed and indiſtinct. This ſhews why their ſight is mended by ſpectacles; and the contrary happens in ſhort-ſighted men, whoſe eyes are too convex and plump: For the refraction being now too great, the rays which come from the ſeveral points of the object, will be made to converge, ſo as to convene in ſo many diſtinct points within the eye, before they come at the retina; and therefore will, after croſſing one another, again diverge, ſo as the picture made in the retina, and the viſion cauſed thereby, will not be diſtinct, unleſs the object be brought ſo near the eye, as that the place where the rays convene may be removed to the retina, or that the plumpneſs of the eye be taken off, and the refractions diminiſhed, by a concave glaſs, or laſtly, that by age the eye grows flatter: Hence ſhort-ſighted men ſee remote objects beſt in old age, and therefore are accounted to have the moſt laſting eyes. But though it is certain that all objects are ſeen perfectly or imperfectly, according as their image on the retina is perfect or imperfect; yet the eye, or rather the mind by means thereof, never

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ſees any ſuch image on the retina, or judges of the object from what it obſerves in this image, but by means of an original and connate law, traces back its own perceptions from the ſenſorium to the retina, from that point of it where the impreſſion is made by the image, to the object itſelf; whence the mind always ſees every point of the object without the eye in perpendicular lines; from which it is eaſy to underſtand why the object appears perfect or imperfect, according as its image on the retina is perfect or imperfect, without having recourſe to the ſuppoſition of the mind's ſeeing a picture on the retina; for when the rays which come from the ſeveral points of the object, are not exactly united upon the retina, the picture of each point being a ſpot, which takes up a conſiderable ſpace upon the retina, and which is confounded with the pictures of the neighbouring points, which alſo are ſpots, it muſt make theſe points to be ſeen in a great many places, and a great many points to be ſeen in the ſame place; from which confuſion the appearance of the object will be confuſed and indiſtinct. Thus (in Plate V. fig. 1.) let COB be an object, whoſe points O, B, and C, by emitting rays, which are not reunited at the retina, but beyond it as far as *x*, do upon the retina, form the circular images *o*, *b*, and *c*; and let F be the center of the eye, through which every line that is drawn perpendicular to the retina muſt paſs. From the extreme points of theſe circular images on the retina, *o*, *b*, and *c*, draw right lines to the point F, and continue them to the horopter as in the figure; theſe lines, by reaſon they paſs through the center of the eye F, will be perpendicular to the retina: Whence it is evident that the points O, B and C muſt be ſeen without the eye, in the whole of the circular ſpaces OCIB, BOLH, and CGKO, which are comprehended between the ſtraight lines drawn perpendicular to the retina, from the extreme points of the images of the reſpective points; which circles being confounded with one another, it follows that the points O, B and C muſt, for the reaſon above obſerved,

obſerved, appear confuſed and indiſtinct, though the eye ſees not the confuſion which is in their images at the retina. From what has been ſaid it follows that in order to ſee objects at different diſtances diſtinctly, it is neceſſary that the eye change its conformation, either by having its humours more or leſs flat, or the diſtance betwixt the cryſtalline and retina increaſed or diminiſhed, leſt the place in which the picture of the object is exact, ſhould fall ſhort of, or beyond the retina, and ſo cauſe the viſion to be confuſed. And this likewiſe further appears, by the analogy of the images painted on the retina, and thoſe painted on a ſheet of white paper, by means of a lens placed at a hole in the window-ſhutter of a dark room; for if the lens be of ſuch a convexity, as is neceſſary to paint the image of a body, at a foot diſtance from it, five or ſix inches behind the lens, the ſame object removed to five or ſix feet from the window, will not be painted exactly upon the paper, unleſs in place of the former lens you ſubſtitute one leſs convex, or diminiſh the diſtance betwixt the lens and paper. And here it may not be improper to obſerve, that the eyes of all animals are formed ſo as, upon all occaſions, to ſee objects diſtinctly at an ordinary diſtance. The cornea is always protuberant, and more convex than the reſt of the globe; but in all animals this protuberance is not always the ſame: In man, and the greateſt part of quadrupeds, the cornea is a part of a ſphere whoſe diameter is an eighth part leſs than that of the ſclerotica; but birds have their cornea more convex, being part of a ſphere whoſe diameter is only half of the diameter of the ſclerotis. This great convexity of the cornea of birds is abſolutely neceſſary for diſtinct viſion; for as in man and quadrupeds, the figure of their eye is almoſt ſpherical, in birds and fiſhes it is flat and depreſſed both in its fore and back parts, by which means the retina is placed near the cryſtalline humour: And therefore, were not the cornea of a convexity, anſwerable to the flatneſs of their eyes and diſtance of the retina, the diſtinct image of the object would

fall behind it, and thereby the ſight would be rendered confuſed and imperfect. To the ſame purpoſe alſo belongs the different figures obſerved in the cryſtallines of different animals. In men, quadrupeds, and the greateſt part of the bird-kind, it is lenticular; in ſuch as always reſide in water, its figure is that of a ſphere, and in amphibious creatures it has a middle figure betwixt that of a lens and globe: With reſpect to man, and ſuch animals as live conſtantly in air, the cryſtallines are of ſuch a degree of convexity, as qualifies them for ſeeing diſtinctly at an ordinary diſtance; fiſhes require their cryſtalline to be ſpherical. For it is obſervable, firſt, that the eyes of fiſhes are flat both behind and before, by which means the retina is not ſo far removed from the cryſtalline as in man and quadrupeds, whoſe eyes are nearly a perfect ſphere; and therefore that the rays might be made to meet at a point on their leſs diſtant retina, it was neceſſary the refraction ſhould be increaſed by the ſpherical figure of the cryſtalline. But this is not all; for their ſpherical cryſtalline would be more than ſufficient for the diſtance betwixt it and the retina, if the rays of light ſuffered no refraction in the cornea and aqueous humour: For light is never refracted but when it falls obliquely on a ſurface which intercedes mediums of different denſities, and therefore it can ſuffer no refraction in falling upon their cornea and aqueous humour, becauſe they are of equal denſity with the water in which they ſwim; to compenſate which, it was abſolutely neceſſary, that their cryſtalline ſhould have a ſpherical figure. But in land-animals, their lenticular cryſtalline is ſufficient for that end; becauſe the rays of light which paſs from the object, through the rare medium air, are refracted in falling upon their convex and more denſe cornea, and therefore need not afterward ſo much refraction in the cryſtalline. From which it is eaſy to ſee why this humour is of a middle figure between that of a lens and a globe, in ſuch animals as duck under water in purſuit

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of their prey; for a ſmall change in the conformations of their eyes, enables them to ſee diſtinctly in both elements. Mr. de la Hire (a), endeavours from ſeveral reaſons to demonſtrate, that the eyes never change their conformation, and particularly from the following experiment. Take a card and pierce it with a pin in two, three, or more places, ſo as the moſt diſtant holes be not farther from one another than the wideneſs of the pupil. This done, ſhut one of your eyes, and apply the card cloſe to the other, ſo as to view a ſmall object through its holes, which will appear multiplied as many times as there are holes in the card, provided it be placed out of that preciſe place, where it would be moſt diſtinctly ſeen by the naked eye.

Now it is certain that if the rays of light, which come from each point of the object, are exactly united in a correſponding point of the retina, the object will always appear ſingle though viewed through ſeveral ſmall holes; for the little luminous cones O H H, O *b b*, (fig. 2.) which have for their apex a point of the object O, and for their baſis the holes in the card H H, *b b*, will alſo have all their oppoſite tops *o*, *o*, in one and the ſame point, *o*, of the retina R R, which muſt needs make the object appear ſingle: But if the eye have not that conformation which is neceſſary to reunite thoſe rays in a point in the retina, each of theſe cones will be cut by the retina, either before or after their reunion; and therefore each point of the object will, by its rays, touch the retina in as many diſtinct places as there are holes in the card, and conſequently the object will appear multiplied according to the number of holes. Thus if the rays convene before the retina, let A B be the retina, it is evident from the figure that this muſt receive the luminous pencils at two diſtinct places *x* and *x*. And if the rays convene behind the retina, let C D be the retina, which alſo muſt receive the luminous cones at the diſtinct places *c* and *c*. In

(a) Journal des Sçavans, Ann. 1685. Diſſert. ſur les differens accidens de la vuë.

both which cafes the object muft appear double. Whence if the card be pierced in three or more holes, fo as the moft diftant be not further from one another than the diameter of the pupil; the luminous pencils, and the places in the retina where thefe pencils fall, muft be multiplied according to the number of holes, whence the object muft alfo be equally multiplied. From all which the above named author concludes, that the conformation of our eyes is never changed, at whatever diftance objects be placed. For fuppofe that I fee an object diftinctly at a foot diftance, and at the fame diftance it appears fingle, when viewed through the perforated card; if to fee the fame object at four foot diftance, it were requifite that the eye changed its conformation; then he concludes it would do fo when the object is viewed at that diftance through the card, which does not happen, as is evident from its being multiplied. For the better underftanding this matter, it may be proper to clear up the ftate of the queftion, by admonifhing the reader, that it is not here meant to enquire, why a fmall object is thus multiplied, when placed without the limits of diftinct vifion; it being evident that it ought then to appear multiplied, by reafon that the eye can never adapt itfelf to its diftance. Thus if I cannot fee diftinctly any object nearer than half a foot, it muft appear multiplied at four inches; and if I cannot fee an object diftinctly further off than two feet, it muft be multiplied at three feet, and all greater diftances. But my meaning is to account for this multiplication, when the object is placed within the limits of diftinct vifion. There are two caufes which concur in producing this phænomenon, by hindering the eye to accommodate itfelf to the diftance of objects viewed through the perforated card, viz. the diftinct appearance of the object and the miftake which the mind commits with refpect, to its diftance. That the object appears diftinct when viewed through a perforated card, is evident both from reafon and experience; for the little luminous cones OHH, O*hh* (fig. 2.) which have for their apex a point in the ob-

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ject O, and for their baſe the holes in the card H H, *h h*, will by reaſon of their acuteneſs, take up but a little ſpace upon the retina, whence the object muſt appear pretty diſtinct. Thus if the object is at too great a diſtance, let *o* be the place where the rays convene, and let A B be the retina; the luminous pencils will fall on the retina at *x* and *x*, where they muſt take up but a little ſpace; and conſequently the confuſion muſt be ſmall. In like manner, if the object is too near, let C D be the retina, and *o* the focal point, theſe pencils will, at *c* and *c*, occupy ſo ſmall a ſpace on the retina, as to occaſion no ſenſible confuſion in the object, whereas in both caſes, without the interpoſition of the card, the luminous cone M *o m* would, on the retina, have taken up the whole ſpace *x x* or *c c*, which muſt have rendered the appearance of the object confuſed. To correct which confuſion, the eye changes its conformation, and adapts itſelf to the diſtance of objects ſeen with the naked eye. But when by the perforated card this confuſion is taken off, the mind will not change the conformation of our eyes. And this is one reaſon why the object is found ſo frequently multiplied according to the number of holes through which it is viewed, though it be placed within the limits of diſtinct viſion. The miſtake into which the mind falls, with reſpect to the diſtance of the object, concurs as another cauſe towards this multiplication. It is not enough that the mind perceives no confuſion: For though this confuſion in our ſight is commonly believed to be the only thing which can influence our mind to change the conformation of our eyes; yet by reaſon of the neceſſary connexion and dependance, which will be hereafter ſhewn to have been eſtabliſhed by habit and cuſtom betwixt theſe motions, whereby the conformation of our eyes is changed, and certain correſponding motions of the axes of viſion, thoſe motions come at laſt always to accompany one another, ſo as to make it impoſſible for the will to direct our eyes to any object within the limits of diſtinct viſion, without giving them the diſpoſition neceſſary for ſeeing

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diſtinctly at that diſtance; and therefore though there ſhould be no confuſion in the object, when ſeen through the perforated card, it would not appear multiplied, if placed within the limits of diſtinct viſion, did not the mind miſtake its diſtance. Mr. de la Hire affirms, that we judge rightly of the diſtance of objects viewed through a perforated card. But in the caſe before us we can ſcarce form any judgment with reſpect to diſtance, but what is wholly founded upon prejudice and anticipation, which cannot fail of betraying us into error. There is another argument brought by the learned author, againſt this change in our eyes, which is that there is no need of any ſuch change; and that the eye can ſee objects diſtinctly enough at different diſtances without it. For underſtanding this, we muſt firſt obſerve, that if an object appear diſtinct at ſix foot diſtance, then at whatever greater diſtance the object be placed, it will alſo appear diſtinct: The reaſon of which is, that when the object is at ſix foot diſtance, the rays which fall upon the pupil are nearly parallel; and therefore at whatever greater diſtance the object be placed, the rays may be conſidered as parallel, and conſequently the ſame conformation of the eye which is neceſſary to refract them ſo as to make the object appear diſtinct at ſix foot diſtance, will alſo refract them in the ſame way, and thereby make it alſo appear diſtinct at all greater diſtances. This being underſtood, the only queſtion is, how the object can appear diſtinct both at the diſtance of ſix foot and of one foot, without ſuffering any change in its conformation. To this the author anſwers, that to ſee objects ſo diſtinctly as not to be ſenſible of any defect in the ſight, it is not needful that the rays which come from a point in the object, ſhould be united accurately in a point in the retina, but that it is ſufficient they ſhould be nearly ſo: Whence he concludes, that if the conformation of the eye be ſuch, that when an object viewed through two holes in a card at two foot diſtance appears ſingle, becauſe all the rays which come from the ſeveral points of

of the object, are united accurately in ſo many points of the retina, when at one foot diſtance, the place where the rays meet will be a little behind the retina, and at ſix foot diſtance it will be a little before it, though not ſo much in either caſe as to render the object undiſtinct; becauſe the rays which come from the ſeveral points in the object, do, in falling upon the retina, meet nearly, though not accurately, in ſo many correſponding points: And therefore, that thoſe who have their eyes of a conformation proper to ſee objects diſtinctly at two foot diſtance, will alſo ſee them diſtinctly enough, both at one foot diſtance and ſix foot diſtance; and then they muſt alſo ſee diſtinctly at all greater diſtances: And thus he accounts for that perfect viſion, which ſtands in the middle betwixt ſhort and long ſight, without any change in the eye. And as for the ſight of old men, who cannot ſee diſtinctly at any leſs diſtance than three feet, he ſuppoſes that their eyes are of a proper conformation to ſee objects at four feet diſtance moſt diſtinctly; from which he infers that at three feet and all greater diſtances the picture of objects upon the retina will be pretty diſtinct, and conſequently they will be ſeen without any ſenſible confuſion, though the eye ſuffers no change in its conformation. In like manner, in thoſe who are ſhort-ſighted, and cannot ſee objects diſtinctly at a greater diſtance than a foot, he ſuppoſes the eye to be of a conformation proper to ſee moſt diſtinctly at half a foot's diſtance; and thence concludes that the picture made on the retina, when the object is at any diſtance betwixt four inches and a foot, will not be confuſed; and conſequently the object will be ſeen diſtinctly enough, without any change in the eye, unleſs its diſtance be greater than a foot, or leſs than four inches; in which caſe the image on the retina will begin to be confuſed. Indeed it cannot be denied but the eye has ſome latitude of ſeeing objects diſtinctly, without changing its conformation: But it does not from thence follow, that our eyes do not change their conformation, when objects are much removed from that place where they

they appear moſt diſtinctly; for experience teaches us, that the conformation of our eyes is changed in viewing objects at different diſtances; for the eye can't ſee equally diſtinct at the ſame time objects at different diſtances; *e. g.* if with one eye, the other being ſhut, you look attentively to a ſmall pin at half a foot from the eye, and at the ſame time place another at ſix foot diſtance, the latter will appear extremely confuſed; but if you obſerve accurately that at ſix foot diſtance, then it will be ſeen diſtinctly, but the other will appear very confuſed; which ſhews, that when the diſpoſition of the eye is ſuch as is neceſſary for making a diſtinct picture of the pin at one diſtance, the place where the diſtinct picture of the other pin is made, muſt fall ſhort of or beyond the retina; and conſequently upon the retina itſelf, the picture muſt be confuſed; and therefore, ſince at pleaſure I can ſee diſtinctly either of the pins, while at the ſame time the other appears confuſed; it follows, that I have a power of changing the conformation of my eye, and of adapting it to the different diſtances of objects; and indeed was it not for the change which is made in the diſpoſition of the eye, it would be difficult to explain how birds which duck in purſuit of their prey ſhould be enabled to ſee both in air and water, ſeeing the refraction which happens in the eye is ſo far different in the one caſe from what it is in the other.

I ſhall now proceed to ſome experiments made for meaſuring the ſtrength and weakneſs of ſight, whereby not only the fallacy of de la Hire's reaſoning will be made further manifeſt, but it will alſo be demonſtrated, that our eyes change their conformation, and adapt themſelves to the various diſtances of objects, within certain limits, which limits will alſo be accurately determined: But that theſe experiments may be the better underſtood, I muſt firſt premiſe the following axioms.

AXIOM I.

When an object, ſeen with both eyes, appears double, by reaſon that its diſtance is leſs than that to which

which the eyes are directed, upon covering either of the eyes, the appearance which is on the contrary ſide will vaniſh; and if it appear double, becauſe its diſtance is greater than that to which the eyes are directed, upon covering either of the eyes, the appearance which is on the ſame ſide will vaniſh. To illuſtrate this, ſee fig. 3, 4, and 5. where A and B are the eyes, *x* the object, which is at a ſmaller diſtance than the point C, to which both eyes are directed; while the eyes continue directed to C, the object *x* is ſeen in two different places, which with reſpect to the horopter, to which all objects are referred, will be D and E; for being ſeen by the right eye B in the direction of the viſual line B *x* D, it muſt, at D, hide a part of the horopter D C E; and being ſeen by the left eye A, in the direction of the viſual line A *x* E, it muſt hide a part of the horopter at E, and therefore with reſpect to the horopter on which the eyes are fixed at C, the object *x* muſt appear to the right eye B as at D, and to the left eye A as at E; and in covering either of the eyes, the appearance which is on the contrary ſide will vaniſh. In like manner, if the eyes are directed to *x*, the object C, which is further off than *x*, will be ſeen by the right eye B, in the direction of the viſual line B *m* C; and by the left eye A it will be ſeen in the direction of the viſual line A *o* C; and therefore with reſpect to the horopter *m x o*, it muſt appear double, as at *m* and *o*; and in covering the right eye B, the appearance which is on the right ſide towards *m* will vaniſh; and in covering the left eye A, the appearance which is on the left ſide towards *o* will vaniſh.

A X I O M II.

When an object appears double, from its being ſeen with one eye, through two ſmall holes made in a card, or any other opaque thin body; if its diſtance be greater than that to which the eye is accommodated, upon covering either of the holes, the appearance which

which is on the ſame ſide will be made to vaniſh; and if its diſtance be leſs than that to which the eye is accommodated, upon covering either of the holes, the appearance which is on the contrary ſide will be made to vaniſh. Illuſtration. Let E be the eye, (ſee fig. 6, and 7.) Q T the card, in which are two ſmall holes *d* and *r*, and let A be a ſmall body at a greater or leſs diſtance than that to which the eye is accommodated. The rays of light A *d*, A *r*, will not, after refraction, converge to a point in the retina, but by reaſon that the diſtance of the object A is greater or leſs than that to which the eye is accommodated, they will be made to converge to ſome other point, either before or behind the retina, ſuch as *o*, but on the retina itſelf they will fall on the different points *i* and *m*, at both which a picture of the object will be formed, from which duplication of the picture, the object itſelf will alſo appear double at C and B, viz. in the right lines *i* C and *m* B, which are ſuppoſed to be drawn perpendicular to the retina from the points *i* and *m*, where the pictures fall. Whence it is evident, that if the hole at *d* be covered, there will be no image at *i*, and conſequently the appearance at C will vaniſh; and if the hole at *r* be covered, there will be no image at *m*, and conſequently the appearance at B muſt vaniſh; but when the object A is at a greater diſtance than that to which the eye is accommodated, as in fig. 6. the appearance which is made to vaniſh by covering either of the holes *d* or *r*, lies on the ſame ſide with the covered hole, but when the object A is at a leſs diſtance than that to which the eye is accommodated, as in fig. 7. the appearance which is made to vaniſh, lies on the contrary ſide of the hole which is covered, as has been affirmed in the axiom. Exper. 1ſt. I took a ſmall tin plate I K (ſee fig. 8.) in which I had cut two parallel narrow ſlits, whoſe diſtance from one another did not exceed the diameter of the pupil. This plate I held cloſe to my right eye B, in ſuch a manner as the ſlits might have a vertical poſition, and having ſhut my left eye A, through theſe ſlits I viewed the

the ſmall object *o*, which alſo had a vertical poſition, and conſequently was parallel to the ſlits. In this experiment, the object *o* was at ſuch a diſtance from the eye B, as to appear ſingle when viewed in this manner through the ſlits; but when both eyes were opened and directed to a more diſtant point, ſuch as P, three appearances were ſeen *a*, *b* and *c*, which appearances were nearer to, or further from each other, according as the point *p* was nearer to, or further from the object *o*, and in covering the left eye A, the appearance *a*, which was on the other ſide, vaniſhed, which therefore belonged to the eye A; and in covering the right eye B, the appearances on the contrary ſide *b* and *c* belonging to the eye B vaniſhed. Hence the diſtance of the object *o* was leſs than that to which the eyes are directed. (ſee axiom 1.) The double appearances *b* and *c* ſeen through the ſlits proceed from the object *o*, being at a leſs diſtance than that to which the eye B was then accommodated; for by covering either of the ſlits with my finger, the appearance on the contrary ſide vaniſhed. (ſee ax. 2.) Next I changed the direction of my eyes, and turned both inwards to a nearer point, ſuch as *x*, by which alſo three appearances were ſeen *d*, *e* and *f*; and theſe were alſo nearer to, or further from one another, according as the point *x* was nearer to or further from the object *o*, but always in a contrary order to thoſe which were ſeen when my eyes were directed as above; whence the diſtance of the object *o* was greater than that to which my eyes were directed. I then covered one of the ſlits, and the appearance which was on the ſame ſide vaniſhed; from which, when compared with the ſecond axiom, it follows that the object *o* is then at a greater diſtance than that to which the eye is accommodated. In making this and all the following experiments, it was neceſſary, that the object *o* ſhould be as conſpicuous as poſſible; the beſt was a narrow ſlit made in a dark lanthorn, in which a candle was put; though ſometimes I made uſe of a black line upon white paper, or a white line upon black paper, both which anſwered very well in all the experiments, wherein the diſtance of the object

exceeded not two feet; but when the diſtance was greater, theſe lines began to be obſcure. It muſt alſo be obſerved here once for all, that though in the above experiment it was eaſy for me to direct my eyes to a diſtance which was either greater or leſs than the diſtance of the object *o*, without the aſſiſtance of any other object, on which my eyes might be fixed; yet in this as well as in many of the ſubſequent experiments, I was ſometimes obliged to put an object in the place towards which both eyes were to be directed; and this was neceſſary either when a great effort was needful to give the eyes the deſigned direction; or when, for obſerving the phænomena more accurately, the experiment required, that the eyes ſhould be kept ſome time fixed in a certain determined direction: when it was required, that my eyes ſhould be directed to a very near diſtance, for the object *o* I made uſe of a black or white line, made on paper of an oppoſite colour; and at the place *x*, to which my eyes were to be directed, I held parallel to my eyes any ſmall object *z*, whoſe extremity *x* I looked at for an object; but when the experiment required, that my eyes ſhould be directed to ſome point at a conſiderable diſtance beyond the object *o*, for the object *o*, I made uſe of the narrow ſlit in the lanthorn, and at the diſtant point *p*, to which my eyes were to be directed, I placed another dark lanthorn, in which was the horizontal ſlit P Q, whoſe extremity P, which was ſeen by the right eye, in the viſual line B *o* P which paſſed immediately above the upper end of the object *o*, ſerved me as a point of view, on which I could eaſily fix both eyes, while I attended to the appearance of the object *o*. From this experiment compared with the preceding axioms, it follows, 1ſt. that we are poſſeſſed of a power of changing the conformation of our eyes, and of adapting them to various diſtances. 2. This change always follows a ſimilar motion in the axis of viſion, with which it has been connected by uſe and cuſtom; for when the eyes were directed to P, the object *o* was ſeen double through the ſlits, and by covering one of

the slits, it appeared that the eye was adapted to too great a distance, and as the point P was brought nearer the object, these appearances approached nearer to one another continually, till at last, when the point P became very nigh to *o*, they coincided in one at *o*, which shews, that the eye was then adapted to its distance. But when the point P was moved along the line *o x*, from *o* to *x*, two appearances of the object *o*, were again seen through the slits; which appearances being in a contrary order from what were seen, when the point P was on the other side of the object *o*, it follows that the eye was then adapted to too small a distance; and as the point P, in its motion from *o* to *x*, receded farther from *o*, these appearances receded farther from one another continually. From all which it is evident, that there is a necessary connexion and dependance betwixt those motions, whereby the conformation of our eyes is changed, and certain corresponding motions in the axis of vision, which makes it impossible to direct our eyes to any object, within the limits of distinct vision, without at the same time giving them the disposition which is necessary for seeing distinctly at that distance; but these two corollaries will be further confirmed by the experiments which follow.

Exper. 2. The distance of the object *o* (fig. 8.) being five inches, I viewed it through the slits, the other eye A being covered; and it appeared double; and upon covering either of the slits, the appearance which was on the contrary side vanished, and therefore the distance of the object was less than that to which the eye was accommodated; and both eyes being open, and directed to *x*, whose distance from the eye was about three or four inches, three appearances were seen, *d*, *e* and F, whereof the appearances *d* and *e* belonged to the right eye B; and when I covered either of the slits, the appearance which was on the contrary side vanished; whence it is evident, that I cannot fit my eyes to so small a distance as five inches.

Exper. 3, 4 and 5. At ſix, ſeven and eight inches diſtance, when one eye was ſhut, the object *o*, ſeen through the ſlits, appeared double, and by covering one of the ſlits, it was evident that its diſtance was leſs than that to which the eye was accommodated. And in looking with both eyes to *x*, whoſe diſtance from the eye was about half the diſtance of the object *o*, a double appearance was ſeen, one at F belonging to the eye A, and the other at *x* belonging to the eye B; but this appearance at *x* was always ſingle, though ſeen through the ſlits; whence it follows, that my eye cannot accommodate itſelf to a diſtance which is much leſs than ſix, ſeven or eight inches. Exper. 6. At the diſtance of nine inches, the object *o* ſeen through the ſlits, the other eye being ſhut, appeared ſometimes ſingle, but moſtly double, when it was evident by covering either of the ſlits, that it was too near with regard to the diſpoſition of the eye; and when both eyes were open and directed to *x*, which was at half diſtance preciſely, three appearances were ſeen, whereof the appearances *d* and *e* belonged to the right eye B, to which the ſlits were applied; and in covering one of thoſe ſlits the object on the ſame ſide diſappeared; whence I was certain, that the object was too far off, and that my eye can be accommodated to a leſs diſtance than nine inches, but not much, as may be learned from the nearneſs of the appearances, as well as from the four laſt experiments. From the five laſt experiments laid together, we may ſafely draw the following corollary, viz. the neareſt limits of diſtinct viſion in my eyes is at about ſeven inches diſtance; for by the ſecond experiment it appears, that my eyes cannot be fitted to ſo ſmall a diſtance as five inches; and by the laſt experiment it is plain, that they can be accommodated to a leſs diſtance than nine inches; and the third, fourth and fifth experiments make it manifeſt that at ſix, ſeven and eight inches diſtance the object ſeen through the ſlits appears always ſingle; whence the middle diſtance ſeven inches, ſeems to be the

neareſt limits of my eye (*a*) and therefore all objects nearer than ſeven inches muſt appear more confuſed, according as their diſtance is leſs than ſeven inches. Exper. 7. In looking to an object at two foot diſtance, through the ſlits, one eye being ſhut, it always appeared double and too far off; and in looking with both eyes to a more diſtant object, it was then alſo ſeen double; but in covering either of the ſlits, the appearance on the oppoſite ſide vaniſhed; hence the object was too nigh, but theſe appearances were ſo cloſe that they almoſt touched one another; which ſhews, that my eyes can ſcarce go further than to accommodate themſelves to the diſtance of two feet. Exper. 8. At two feet and a half, three foot, and all greater diſtances, the object *o* not only appeared double, and too far off, when viewed with one eye through the ſlits, but when both eyes were open and directed to a very diſtant object, the double appearance which was then ſeen through the ſlits was ſuch, as by covering one of the ſlits, made it evident, that even then the object alſo was too far off; from which it follows, that my eyes can never be accommodated to ſo great a diſtance as two foot and a half. Corol. From this and the preceding experiment it ſeems probable that the furtheſt limit of my ſight reaches to the diſtance of about twenty ſeven inches (*b*), for by exper. 7. I can accommodate my eye to a diſtance greater than two foot; and by the laſt experiment my eye cannot accommodate itſelf to ſo great a diſtance as two

(*a*) As a proof of this we have the concurrent experience of the generality of perſons who are at their full growth, and whoſe eyes are no way impaired by age; for in looking at minute objects, they hold the objects at five, ſix or ſeven inches from the eye, whence it may reaſonably be preſumed that the neareſt diſtance for perfect viſion, is commonly five, ſix, or ſeven inches.

(*b*) That to the generality of eyes this diſtance is much greater may be reaſonably preſumed from the diſtinctneſs with which we ſee a ſmall miſling rain when walking in a piazza, or coming out of a church, and within not leſs than ſix or eight feet from the door; or the ſmall filaments of ſilk on which ſpiders tranſport themſelves through the air at a greater diſtance; or the ſtring of a boy's kite at a great height in the air.

feet and a half; whence the furtheſt limit of my ſight lies about the middle diſtance betwixt both. Exper. 9. and 10. At ten and twelve inches diſtance, the object *o* ſeen with one eye through the ſlits, did, as in the 6th exper. where it was at the diſtance of nine inches, appear ſometimes ſingle, but frequently double and too nigh. Exper. 11 and 12. At the diſtance of fifteen and eighteen inches, one eye being ſhut, the object *o*, ſeen through the ſlits, appeared ſometimes ſingle and ſometimes double, but when it was double, by covering one of the ſlits, it was always found to be too far off. Corol. From the four laſt, as well as from ſome of the preceding experiments, it is manifeſt, firſt, that the eye frequently miſtakes the diſtance of the object, ſeen through the ſlits; for when its diſtance lies betwixt the limits of diſtinct viſion, to which the eye can eaſily accommodate itſelf, it would never appear double, did not the mind miſtake its diſtance. When both eyes are open, and directed to the object, it appears ſingle at all diſtances within the limits of diſtinct viſion, by reaſon the eye is then accommodated to its diſtance, which is then known to us, by means of the angle which the optic axes make at the object. Secondly, the judgment which the mind forms with reſpect to the diſtance of objects ſeen with only one eye through the ſlits, is not always the ſame, but is fluctuating and inconſtant, as may be gathered from the four laſt experiments, where the object ſometimes appeared ſingle, and at others double, and when it appeared double, the diſtance betwixt the appearances was not conſtantly the ſame. Thirdly, if the object ſeen through the ſlits, one eye being ſhut, is not much beyond the neareſt limits of diſtinct viſion, when the mind miſtakes its diſtance, it imagines it further off than it really is, as is evident from the 4th, 5th, 6th, ninth and tenth experiments. But, fourthly, when the object is not a great deal nearer than the furtheſt limits of diſtinct viſion, when we miſtake its diſtance, we imagine it nearer than it really is, whence it appears double, becauſe

caufe it is too far off with refpect to the conformation of the eye, as appears from the feventh, eleventh and twelfth experiments. If it fhould be here enquired why the mind miftakes the diftance of the object feen through the flits, one eye being fhut? To this I anfwer, that by running over all the means the mind can poffibly employ for judging of the diftance of objects, which means we fhall have occafion to touch upon below, it will appear that in the cafe before us, we can fcarce form any judgment with refpect to diftance, but what is entirely founded upon prejudice and anticipation. Having thus demonftrated that our eyes change their conformation, and adapt themfelves to the different diftances of objects, it remains, that we examine wherein this change confifts, and by what mechanifm it is introduced, about which authors are divided in their opinions: The chief of which we fhall now confider, and fix upon what we think moft probable, leaving every one at liberty to differ from us as he fees reafon. Some are of opinion, that the whole globe changes its figure by being lengthened into an oblong figure when objects are near, and by becoming flat when they are removed to a greater diftance. This accounts for the diftinct appearance of objects at different diftances; for according as objects are nearer or farther from our eyes, their images will be painted at different diftances behind the cryftalline humour: And therefore if we have a power of rendering the eye flat or oblong, the retina will be brought to the precife place behind the cryftalline, where the perfect image of the object is made. Now this change in the figure of the eye is differently explained by authors: Some maintain (a) that it is rendered oblong by the joint contraction of the two oblique mufcles, or both the oblique mufcles fqueeze the middle of the bulb of the eye to render it oblong when objects are too near us. But this is by no means probable; for that the eye may be rendered oblong by the contraction of thefe mufcles, it is neceffary to fuppofe

(a) Keil anat. chap. 4. fect. 4.

that they preſs its ſides inwards towards its axis; but their diſpoſition is not proper for this effect. But there is yet another argument againſt the eye's changing its conformation, when theſe muſcles contract; which is, that in ſeveral creatures, their diſpoſition is very different from what it is in man. Thus in the pike, they are both ſituated in the under ſide of the eye, where they decuſſate one another in form of a croſs, as has been obſerved by Aquapendens and Perrault: In the canis carcharia, and ſome other fiſhes of the dog-kind, Steno (a) obſerved, that the ſuperior obliquus had no trochlea, but that its origin and progreſs was altogether ſimilar to the inferior obliquus; and Peierus (b) tells us, that the grandis obliquus is alſo without any trochlea both in geeſe and hares; whence it is improbable, that theſe muſcles ever ſqueeze the eye ſo as to render it oblong, and yet they have a power of accommodating their eyes to the different diſtances of objects. Another opinion concerning this change of our eyes is that the four ſtraight muſcles acting together, compreſs the ſides of the globe, and reduce it to an oblong figure, when objects are near; and that by its elaſticity it recovers its former figure, when theſe muſcles ceaſe to act. There are many objections which render this opinion doubtful, if not abſurd. For when theſe muſcles act together they muſt draw the eye inwards, and preſs its bottom againſt the fat, which touches it in that place: But action and re-action being equal, it follows, that the back part of the eye muſt be preſſed forwards by the fat, with as much force as the muſcles draw the eye inwards; and conſequently, that the force whereby theſe muſcles endeavour to lengthen the eye, by ſqueezing its ſides, muſt be balanced and taken off, by the preſſure of the fat againſt the back part of the eye. The other objections againſt this hypotheſis will be taken notice of below. Others again would perſuade us, that when theſe four ſtreight muſcles act

(a) Canis carchariæ diſſectum caput. Diſſect. piſc. ex canum genere. (b) Obſervat. anatom.

together,

together, they render the eye flat by pulling it inwards, and preſſing its bottom againſt the fat, and that it is again reduced to its former figure either by the joint contraction of the two oblique muſcles, or by the elaſticity of its parts: But neither does this opinion appear probable; for when theſe muſcles contract, they not only endeavour, by preſſing the eye againſt the fat in the bottom of the orbit, to render it flat, but likewiſe ſqueeze the ſides of the eye, and therefore, at the ſame time endeavour to render it oblong, which two actions being equal deſtroy each other. From what has been ſaid, it ſeems probable that the eye can neither become flat nor oblong either by the action of the ſtreight or oblique muſcles: And this further appears from the following reaſons. Firſt, if the eye accommodated itſelf to the diſtance of objects by any change in its figure ariſing from the contraction of its muſcles, this change would be different in different poſitions of the eye, and only regular in one ſituation of it. Secondly, If you preſs your eye gently with your finger, all objects ſeen with that eye appear confuſed, whatever diſtance they are placed at. This is occaſioned by the diſturbance made in the determined ſituation of the fibres of the retina which is neceſſary for diſtinct viſion: And therefore it is not eaſy to underſtand how the ſame diſpoſition ſhould not be equally diſordered by that ſuppoſed compreſſion of the muſcles which is neceſſary for changing the figure of the eye. A third argument againſt this change of figure in the eye, is, that in ſome creatures the ſclerotica is ſo hard as not to allow of any ſuch change: Birds and fiſhes have it bony from the middle of the globe to its fore part, where it joins the cornea, as has been obſerved by Aquapendens and others. Mr. Ranby obſerves, that the ſclerotica of the oſtrich conſiſts of fifteen bony ſcales joined to one another ſo as to make one circular bone round the cornea (a). And Mr. Warren (b) has ſince found that the oſtrich has this ring in common with other fowls both of the water

(a) Phil. Tranſ. VII. iii. 435. abr. (b) Ibid. 437.

and land, with this difference only, that the ring in water-fowls consists of fifteen, and in land-fowls but of fourteen bones, and that one bone lies over the ends of two others, then three or four over one another like the scales of fish; but he thinks Mr. Ranby's figure does not express it justly, which Ranby himself in another paper seems to acknowledge. It is certain, that in all fowls as well as fishes a great part of the sclerotis is hard and inflexible: And particularly in the owl, Perrault speaks as if it was wholly bony, yet Peierus makes it a little softer towards the entry of the optic nerve. But what makes most for our purpose, is, that in some fishes the whole of the sclerotica is of a cartilaginous or bony substance; thus it is in the whale, in which also its thickness is more than an inch (a). In the sea-fox, this tunicle, though thin, was found so hard that it might rather pass for a bone than a cartilage (b). And the like has been observed by Steno in the canis carcharia, and some other fishes of the dog-kind (c). From these observations it is plain, that in many animals it is impossible that the eye can accommodate itself to the different distances of objects, by varying its figure, the action of its muscles being insufficient to overcome the resistance of its cartilaginous, or bony and almost inflexible tunicles; and yet they change the conformation of their eyes, and adapt them to the distance of objects, which therefore we must expect to find somewhere else than in any of its muscles. I must own indeed, that though the change made in the eyes of birds and fishes cannot proceed from the action of its muscles, that it does not follow that in men and other animals, who have the tunicles of the eye flexible and yielding, the contraction of these muscles may not produce some variation in the figure of the eye; yet if we consider how consonant and conformable nature is to herself in all her

(a) Ruysch. Thesaur. Anatom. Maxim. N. LI. (b) See the memoirs of the French academists for the natural history of animals. (c) Can. carchar. dissect. caput. Sanctorini observat. anatom. cap. iv. sect. 2.

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actions, we can hardly doubt but the ſame cauſe which in fiſhes and birds fits their eyes to the viſion of objects at different diſtances, produces the ſame change in the eyes of men; eſpecially ſince there is nothing to be found in the eyes of theſe creatures capable of producing that change, but what alſo obtains in the human eyes. Some have feigned certain fibres going from the choroides to the cryſtalline in birds; and others have ſuppoſed that in fiſhes there is likewiſe a peculiar diſpoſition for adapting their eyes to the diſtances of objects. But with reſpect to birds, Perrault has particularly obſerved, that there are no ſuch fibres different from thoſe which compoſe the marſupium nigrum, which can never anſwer that end, being adapted to another purpoſe, to be hereafter explained; and as for fiſhes, that pretended mechaniſm is ſo darkly explained, and only by authors of little character and reputation, that it does not deſerve credit. But, 4. The following obſervation puts this matter out of diſpute. A man having a cataract in both eyes which entirely deprived him of ſight, had the cataracts couched. After the operation he could not diſtinctly ſee objects, even at an ordinary diſtance, without the help of a very convex lens; which is obſerved to be neceſſary to all thoſe who have had a cataract couched: Neither is the reaſon thereof difficult, for as a cataract is an opacity in the cryſtalline, and as the couching of a cataract conſiſts in introducing a needle into the eye, and turning down the opaque humour below the pupil, it is evident that the cryſtalline cannot be diſplaced and turned down to the under part of the eye, but the vitreous humour muſt in giving way to it, be puſhed into its place; but becauſe its denſity is leſs than that of the cryſtalline, it follows, that the rays of light will be leſs refracted, and therefore will not meet at a point in the retina, but at ſome diſtance behind it; from whence the ſight muſt be confuſed, unleſs a glaſs of a due degree of convexity, be brought to aſſiſt, which by refracting the light, may render its rays more converging, and thus ſup-

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ply the refraction which is wanting in the eye, by the depreſſion of the cryſtalline. But this is not all that happens after the depreſſion of the cataract, for it was obſerved, that the ſame lens was not equally uſeful for ſeeing all objects diſtinctly, but that he was obliged to uſe glaſſes of different degrees of convexity, ſtill the more convex the nearer the object. To make this experiment with great exactneſs, and to provide againſt all poſſibility of miſtake, it is proper to cover the ſide of the lens, which is next to the eye, with black paper, in the middle of which two narrow parallel ſlits have been made, whoſe diſtance from one another exceeds not the diameter of the pupil. By this means, if the eye ſtill retains its faculty of changing its conformation, a ſmall object at ſuch a diſtance as to appear ſingle through the ſlits, when the other eye is ſhut, may be made to appear double by opening both eyes and directing them to a nearer or more remote object; whence if no ſuch double appearance can be ſeen, we may conclude that the eye has loſt its power of accommodating itſelf to the diſtance of objects. Corol. 1. From what has happened in couching the cataract, the eye loſes the faculty of adapting itſelf to the various diſtances of objects. Cor. 2. If the change in the eye neceſſary for ſeeing objects at different diſtances, depends upon the action of its muſcles, then after the depreſſion of a cataract, the ſame lens will anſwer all objects, however diſtant; but ſince this is not fact it follows, that however the muſcles of the eye may be ſuppoſed to change a little its figure, yet this change is not ſufficient to provide for the diſtinct viſion of objects at all diſtances. Cor. 3. Seeing that nothing happens in the eye in couching the cataract, but the depreſſion of the cryſtalline, it follows that the change made in our eyes, according to the diſtance of objects muſt be attributed to this humour. It remains now that we enquire what this change is, and how it is produced. Some maintain that according as objects are at different diſtances, this humour becomes more or

leſs

lefs convex; which indeed accounts for diftinct vifion at all diftances. Others are of opinion that the cryftalline never changes its figure, but that it is moved to and from the retina, according to the diftance or proximity of the object; and this alfo equally well accounts for the diftinct appearance of objects at all diftances. Thofe who embrace the firft opinion fay that the ligamentum ciliare, which arifes all round from the infide of the circle of the choroides where it joins the uvea, does by its contraction draw the edge of the cryftalline, to which it is attached all round, towards that circle; and by that means make it broader and flatter than before, when objects are at a diftance from the eye; and that when we view nearer objects, this ligament is relaxed, and the cryftalline recovers its convexity by the elafticity of its parts. To render this more probable, they contend that nature has made the outer part of this humour of a fubftance eafily flexible and yielding, that it may with greater facility yield to the contraction of the ligament. But the fituation of the ligamentum ciliare difqualifies it for rendering the cryftalline more flat, by increafing its breadth; for its fibres are not in the fame plane with the cryftalline, but have an oblique direction as in fig. 9. where C is the cryftalline humour, *a* C *a* its tranfverfe diameter, *a o*, *a o*, the ligamentum ciliare. Nor is this opinion rendered more probable from the different fubftances of which the cryftalline is compofed: It is indeed true that though this humour is all very folid, in refpect of the other humours of the eye; yet it is not throughout of the fame confiftence, being externally like a thick gelly, but towards its center of a confiftence equal to that of hard fuet: This external foft part of the cryftalline is reckoned to be about the third of its whole bulk. But it does not from this follow, that nature has thus foftened the external part of this humour, that its figure may be more readily varied for feeing diftinctly at all diftances, but for another very wife and neceffary purpofe: For the rays of light which fall upon the extremity of the cryftalline, by reafon

reaſon of their greater obliquity muſt be more refracted than thoſe which fall near its axis, by which means they will meet at different diſtances behind the cryſtalline humour, thoſe towards its extremity nearer, and thoſe near its axis at a greater diſtance; ſo that it is impoſſible for all to be united exactly upon the retina; to prevent this inconveniency, towards the center of the cryſtalline its ſubſtance is more denſe, that the rays which fall on the cryſtalline near its axis, may in paſſing this nucleus have their refraction increaſed, and by that means may be made to meet at the ſame point with thoſe which paſs the cryſtalline towards its edge: This is the reaſon why the cryſtalline of animals is more ſolid in its center than externally, and why in fiſhes this difference is ſo remarkable; for in them this humour being ſpherical, the rays which fall thereon at ſome diſtance from its axis, by reaſon of their great obliquity, would meet at a greater diſtance from the point of union of the other rays which paſs near its center, than in land-animals. If a lens covered with opaque paper, in which there are two holes, one at the axis and another towards its edge, be placed in a hole of the window-ſhutter of a dark room, ſo as to refract a beam of the ſun's light upon a ſheet of white paper placed at the focal diſtance, the beam which paſſes the hole towards the edge of the lens, will cut the axis before the focus of the glaſs and fall on the oppoſite ſide of the paper. The uſe therefore of the different conſiſtency of the cryſtalline humours is, to diminiſh the refraction whereby to diſpoſe them to meet in the ſame point with thoſe which paſs through its middle. If it ſhould be ſaid that the cryſtalline changes its conformation by the action of muſcular fibres which enter its compoſition, it is incumbent on thoſe who entertain this opinion to ſhew us theſe fibres: The cryſtalline when dried manifeſtly appears to be made up of many thin concentrical ſcales lying one upon another, of which Leeuwenhoeck reckons there may be two thouſand in one cryſtalline from the outermoſt to the center, and every one of theſe ſcales, he

ſays,

ſays, he has diſcovered to be made up of one ſingle fibre or fine thread wound this way and that ſo as to run ſeveral courſes and meet in as many centers, and yet not to interfere or croſs one another in any one place. In oxen, ſheep, hogs, dogs and cats, the thread ſpreads into three ſeveral courſes, and makes as many centers; in whales five; but in hares and rabbets only two; in the whole ſurface of an ox's cryſtalline, he reckons there are more than twelve thouſand fibres: This diſpoſition is ill qualified for changing the figure of the cryſtalline. But ſuppoſing it were well qualified, it would not be eaſy to prove theſe fibres to be muſcular and capable of contraction. There is yet another argument againſt this hypotheſis of the cryſtalline's changing its figure, by means of muſcular fibres which enter its compoſition. It has no viſible communication with any part of the body, but is kept in its place by means of a membranous capſule, with which it has not the leaſt connexion: Hence, when this capſule is opened, the cryſtalline ſlips out, as has been obſerved by Maitre-Jean (a) and Dr. Petit (b). This opinion is very much ſtrengthened by Steno (c) one of the moſt accurate anatomiſts in his time, who diſcovered no attachment of the cryſtalline to its membrane or capſule, in the numerous obſervations which he had the opportunity of making.

Morgagni (d) obſerves that there is water in the capſule of the cryſtalline, not only in men but in ſeveral other creatures, and yet he takes no notice of any attachment. But of all the authors who have written on this ſubject, Dr. Petit ſeems to have carried his obſervations the furtheſt; for he found this water not only in the human eyes, but in the eyes of dogs, cats, wolves, hares, rabbets, ſheep, lambs, calves, oxen, horſes, turkies, ducks, &c. but could never diſcover the leaſt attachment (e). Had the cryſtalline any con-

(a) Maladies de l'Oeil, chap. ix. (b) Mem. de l'Acad. Roy. des Scien. Ann. 1730. (c) Can. Carchar. diſſ. cap. (d) Adverſar. vi. p. 90. (e) See les Mem. de l'Acad. Roy. an. 1730.

tinuity

tinuity with its capſule, it is probable that Ruyſch's ſubtle injections would have reached it (a). Seeing then the cryſtalline has no viſible attachment or communication with any part of the body, it can never receive into its fibres any blood or ſpirits, and conſequently it cannot be adapted to the diſtance of objects by the contraction of thoſe fibres. As to its nouriſhment, it may draw it from the water in which it fluctuates, as Maitre-Jean and Petit have ſuppoſed; and this may be the reaſon, that when this water is wanting, as ſometimes happens in morbid caſes, the cryſtalline becomes dry and opaque, as Briſſeau, Morgagni and Petit have obſerved. The laſt opinion concerning the change made in our eyes is what we embrace, and conſiſts in the motion of the cryſtalline, whereby the diſtance betwixt it and the retina is increaſed or diminiſhed according to the different diſtances of objects; ſo that at whatever diſtance objects are placed, the retina is always at a due focal diſtance behind the cryſtalline. The ligamentum ciliare when it contracts, not only draws the cryſtalline forward, but alſo compreſſes the vitreous humour lying behind it, by which compreſſion it muſt preſs upon the cryſtalline, and puſh it forwards further from the retina: For underſtanding which, let C (fig. 9.) be the cryſtalline, and let the curve lines *a o*, *a o* repreſent the ligamentum ciliare, it is eaſy to ſee that when this ligament contracts, it muſt draw the cryſtalline forwards in the direction of the right lines *a o d*, *a o d*, by which means this humour will be brought nearer the forepart of the eye *o o*: But this is not all; for the fibres compoſing this ligament or muſcular proceſs, run not in a ſtraight line from their origin in the choroides, to their inſertion in the edge of the cryſtalline, but by their inflexion form an hollow, behind which lies the vitreous humour; and therefore, when they contract, they muſt come nearer to the ſtraight lines *ao*, *ao*, by which means this concavity will become leſs, and the

(a) Ruyſch. Theſaur. 2. locul. are. 4.

vitreous

vitreous humour will be compreſſed; which therefore muſt, by preſſing on the back of the cryſtalline, puſh it forwards further from the retina when we look at near objects, its axis all this while remaining the ſame. Plempius aſcribes the diſcovery of the uſe of this ligament in changing the conformation of our eyes, to Kepler. But in explaining this matter, not only Kepler, but Plempius himſelf have fallen into a miſtake; for they ſuppoſe that by the contraction of this proceſs, the ſides of the eye are drawn inward toward the cryſtalline, by which means the eye is elongated, and the retina puſhed back to a greater diſtance behind the cryſtalline when objects are near, which is repugnant to the ſituation of this proceſs, as well as to the hardneſs and inflexibility of the ſclerotis of ſeveral animals (a). Mr. de la Hire denies this motion of the cryſtalline, and maintains that it is impoſſible the cryſtalline can change its ſituation, becauſe the ciliary ligament is not muſcular, and conſequently has no power of contraction. But he grounds his opinion on the ſuppoſition that all muſcles are red; the contrary of which appears from the muſcular fibres of the inteſtines: It is alſo certain that the pupil contracts and dilates itſelf, according as objects are more or leſs luminous, and yet none of the fibres which perform that action are in the leaſt red; whence it follows that the fibres of the ligamentum ciliare are not to be deprived of a power of contraction becauſe of a colour different from what generally obtains in other muſcles; nor are we to be ſurprized that ſo many accurate anatomiſts, after a careful examination of this proceſs, have not ſcrupled to affirm it to be truly muſcular. I ſhall now make a few obvious reflections on what has been ſaid, by way of corollaries: And firſt, ſeeing that the natural ſtate of the ligamentum ciliare, like that of all other muſcles, is a ſtate of relaxation, the cryſtalline muſt then be as near to the retina as poſſible; whence it follows that the eye is naturally diſpoſed to ſee diſtinctly only diſtant

(a) See Plemp. Ophthalmogr. lib. iii. cap. 9.

objects,

objects, and that that diſpoſition whereby it is fitted for the viſion of near objects, ariſing from the contraction of this ligament, is a ſtate of violence introduced at the command of our will: For confirmation of which we might appeal to every one's experience, who, we doubt not, will acknowledge, that when they are ſitting careleſsly, without attending to any object, nothing at an ordinary diſtance appears diſtinct, till a certain effort be exerted, which will be remarkably greater in proportion as the viſible object is nearer; and this alſo agrees perfectly well with that neceſſary connexion and dependance which habit and cuſtom has eſtabliſhed betwixt the cryſtalline and certain correſponding motions in the axes of viſion, which makes it impoſſible for us to direct our eyes to any object without giving them the diſpoſition neceſſary for ſeeing diſtinctly at that diſtance; for as our eyes are naturally adapted for ſeeing diſtinctly only diſtant objects; and as the diſpoſition for near objects is a ſtate of violence which requires an effort greater or ſmaller, as the object is nearer or further off, ſo the axis of our eyes are naturally parallel, which is the direction proper for diſtant objects; and when they are directed to a near object, an effort muſt be exerted, which alſo muſt be greater or ſmaller, in proportion as the object is nearer or further off, which harmony and agreement of motions is a great confirmation of this doctrine. Secondly, hence our eyes are ſoon fatigued in looking to near objects, which ſeldom happens when the object is at any conſiderable diſtance; for when the object is near, an effort muſt be exerted, both by the muſcles of our eyes for giving them the neceſſary direction, and by the ligamentum ciliare for giving them the neceſſary conformation; which effort being always greater in proportion as the object is nearer, muſt be painful and laborious when the object is very nigh; but when the object is at any conſiderable diſtance, ſo great an effort is not required, eſpecially by the ligamentum ciliare. Thirdly, from this alſo it is eaſy to underſtand, whence it comes to paſs, that after the eye has

been

been very attentive, in confidering an object at a determined diftance, it cannot prefently fee another object diftinctly, at a greater or lefs diftance, though both objects feem to touch one another, being nearly in the fame line : For fince the conformation of the eye muft be fitted to the diftance, fome time will be required for finding out by repeated trials the precife difpofition neceffary for feeing the object at that diftance. Fourthly, this motion of the cryftalline being intirely voluntary and fubject to our mind, which wills its motion, that objects may not appear confufed, it follows that when by any other means this confufion is taken off, the mind will not then change the conformation of our eyes, unlefs there be fomething elfe which can influence it to fuch an action ; and this is the reafon why the eye is not adapted to the diftance of objects, viewed though a fmall hole made in a card ; and why, when viewed through feveral fmall holes, they appear multiplied according to the number of holes. Fifthly, though this motion of the cryftalline is fubjected to our mind, which, when the object appears confufed, changes its fituation, till it finds out the place it ought to poffefs, and though this confufion in our fight is the only thing which fhould influence our mind to fuch an action ; yet by an habitual or cuftomary connexion which has grown up between the motions of the cryftalline and correfponding motions of the axes of vifion, thefe motions come at laft always to accompany one another, and that fo neceffarily as to make it impoffible for us to feparate them by any act of volition. Whence it is eafy to fee how our eye may be made to change its conformation when an object is viewed through a fmall hole in a card, though by reafon of the fmallnefs of the hole, the object appears always diftinct, even when the eye is not adapted to its diftance ; for feeing the motion of the cryftalline is by cuftom and habit, made to follow a correfponding motion in the axes of our eyes, it follows, that by changing the direction of our eyes, the eye muft alfo at the fame time accommodate itfelf to the diftance

at which the optic axes meet. It is for this reaſon, that when a ſmall body appears ſingle, when viewed through two ſmall holes, whoſe diſtance does not exceed the diameter of the pupil, it may be made to appear double; and if its diſtance is ſuch as makes it appear double, the diſtances betwixt the appearances may be increaſed or diminiſhed, and all this only by changing the direction of our eyes. Sixthly, this motion of the cryſtalline, by which our eyes are adapted to the diſtance of objects, has its limits; whence it is that none of us can ſee diſtinctly with the naked eye, but within certain limits, which are at different diſtances, according to the differences of peoples eyes; and often in the ſame man both eyes have not the ſame limits, which is often times of the ſame uſe as if the limits of both eyes were more diſtant from one another; for one may ſee an object diſtinctly enough with only one eye; but if the neareſt limit of one eye is further off than the furtheſt of the other, then near objects and diſtant objects may be ſeen diſtinctly, but the intermediate ones muſt appear confuſed. Seventhly, the ligamentum ciliare being the only inſtrument by which our eyes can be fitted for ſeeing diſtinctly at different diſtances, it follows that whatſoever affects the œconomy and action of this ligament, muſt alſo affect our ſight. Thus firſt when it has become paralytic no near object will appear diſtinct (a). Secondly, if this ligament ſhould be convulſed, no diſtant object will appear diſtinct. We have a caſe to this purpoſe by Timæus (b). The author indeed reſolves this caſe into a thickneſs and muddineſs of the humours of the eye; but to me it ſeems more reaſonable it ſhould have been reſolved into a contraction or ſpaſm of the ciliary proceſs, and if by means of a concave glaſs of a due degree of concavity, diſtant objects could have been diſtinctly ſeen (of which the author has taken no notice) this would

(a) See Foreſt. Obſervat. lib. ii. obſervat. 36. (b) Timæi Caſ. medicinal. lib. i. Caſ. 25.

have ſerved as a proof of our conjecture; for on Timæus's ſuppoſition, as alſo on the ſuppoſition that this ſymptom proceeded from a certain degree of inſenſibility in the retina, or immediate organ of ſight, ſuch a glaſs would have rendered the ſight yet more dark and confuſed than before. From this we may poſſibly ſee why in hyſteric and nervous caſes, a certain dimneſs of ſight is ſo frequently complained of. For though this ſymptom may ariſe from a numbneſs or certain degree of paralyſis, and inſenſibility in the optic nerve, yet as certain it is, that it may alſo proceed from a ſpaſm in this muſcular proceſs; and ſeeing both are equally poſſible, I ſee no reaſon for admitting the one and rejecting the other, without a very exact and impartial examination of all the phænomena which in ſuch caſes are commonly overlooked. Hippocrates has obſerved this dimneſs of ſight to be the attendant as well as the harbinger of ſpaſms and convulſive motions; whence it ſeems reaſonable to ſuppoſe that in many ſuch caſes it ſhould alſo itſelf be occaſioned by a ſpaſm in this proceſs, whereby the eye is diſqualified for ſeeing diſtinctly at an ordinary diſtance. In the caſe of poiſons, the matter ſeems ſomewhat plainer; for as Nicander, Dioſcorides and others have long ago obſerved that this dimneſs of ſight, together with ſpaſms and convulſions are the conſequences of hemlock taken internally; ſo it ſeems evident from Ægineta (a), that this does not proceed from any degree of inſenſibility in the organ of viſion. Thirdly, if this muſcular proceſs ſhould be paralytic in one ſide and ſound in the other, the cryſtalline muſt get an oblique ſituation when we look at near objects, whence they will not appear diſtinct, unleſs the eye be turned aſide from the object. And fourthly, if this ſame proceſs is convulſed on the one ſide, while the other ſide is healthful, the other ſide will alſo get an oblique ſituation, but not unleſs we view diſtant objects, in which caſe

(a) Lib. 5. cap. 41.

alſo it will be neceſſary to turn our eye away from the object it would view, that its picture may fall on the retina towards the axis of the eye. But, fifthly, if in the one ſide it ſhould be convulſed, while it is paralytic in the oppoſite ſide, the cryſtalline will always have an oblique poſition at whatever diſtance the object is placed: And therefore a ſtrabiſmus ariſing from this cauſe muſt be uninterrupted; whereas in the two former caſes it only takes place in certain circumſtances. But for the better underſtanding what has been ſaid on this and the two preceding heads, it may be proper to review what I have already ſaid of the ſtrabiſmus; from which it will alſo appear that in all theſe obliquities of the cryſtalline, the object will not be ſeen in its proper place, from which it muſt appear double. Sixthly, when this ligament has become rigid and ſtiff, the cryſtalline will have but very little motion, whence the limits of diſtinct viſion will be very narrow: Thus it is with all thoſe who are much employed in any ſubtile work, ſuch as Engravers, Jewellers, Watchmakers, &c. who are apt to become ſhort-ſighted from their conſtant application to ſmall objects, which cannot be diſtinctly ſeen but at a very ſmall diſtance, and therefore they are obliged, by the contraction of this ligament, to bring the cryſtalline as near to the retina as poſſible; but all muſcles which continue long in the ſame ſtate, become rigid and loſe much of their activity; and therefore this ligament by its conſtant contraction, muſt at laſt ſhrink and have its fibres ſhortned, which will keep the cryſtalline fixed in that ſituation, by which the eye is diſqualified for ſeeing diſtant objects diſtinctly. This has been obſerved by Ramazzini (a), who therefore judiciouſly adviſes all ſuch from time to time to intermit their work, and recreate their eyes with a diverſity of objects, leſt they ſhould loſe their mobility and become ſhort-ſighted. The reverſe of this diſeaſe happens to ſuch as are ſeldom employed in obſerving near objects, but who from their infancy

(a) De morbis artificum cap. 26.

have

have accuſtomed themſelves to look much to diſtant objects, ſuch as hunters, hawkers, ſailors, &c. In thoſe this ligament is much relaxed, by which they can ſee at a great diſtance; but by reaſon they are ſo little accuſtomed to obſerve near objects, it loſes much of its faculty of contraction whence they cannot accommodate their eyes to near objects. The eighth and laſt reflexion I ſhall make on this ſubject ſhall reſpect the cauſe of this change of conformation in our eyes, which is either efficient or final. As to the efficient cauſe, it has been already demonſtrated that this lies in the ligamentum ciliare; which being muſcular does by its contraction change the ſituation of the cryſtalline, according as the object is nearer or further off: But leſt it ſhould be imagined that our mind does not preſide over this motion of the cryſtalline, by reaſon we are ſo very little conſcious of its influences; it muſt be obſerved that there are many other motions which are no doubt voluntary and depending on our mind, of which we are as little conſcious. No body denies, but the mind preſides over the muſcles which tune the ear; and yet we are not conſcious of their acting; the motions of the eye-lids are alſo all voluntary, though we are often inſenſible of them, and even in many caſes cannot by an act of volition hinder them to move in a particular manner: Thus when the eyes are turned up or down, the eye lids always follow their motion, and keep at the ſame diſtance from the pupil; and if a body be haſtily moved towards our eyes, they will ſhut without our being conſcious thereof; neither is it in our power to do otherwiſe becauſe we have accuſtomed ourſelves to do ſo on the like occaſions; for ſuch is the power of cuſtom and habit, that many actions which are no doubt voluntary, are in certain circumſtances rendered ſo neceſſary, as to appear altogether mechanical and independent on our wills. I ſhall proceed to the final cauſes of this change of conformation of our eyes. It has already been ſhewn in general that had the eyes continued invariably the ſame, there could have been no diſtinct viſion,

ſion, but at one determined diſtance, either great, middle, or ſmall, according to the particular diſpoſition of people's eyes: But that the ſeveral phænomena ariſing from this defect of our eyes, and the benefits we receive from the change of their conformation may be better underſtood, I ſhall briefly explain the phænomena which attend ſhort and long ſight, to which the caſe before us is altogether ſimilar, except that in the myopia and viſus ſenilis there is always ſome latitude of ſight; whereas if the cryſtalline changed not its ſituation, diſtinct viſion would be confined to one determined diſtance. By myopes, or people who are ſhort-ſighted, I underſtand ſuch as have the cornea and cryſtalline, or either of them too convex, or have the diſtance between the retina and cryſtalline too great. From this diſpoſition of the eye, it is plain that, Firſt, the diſtinct picture of objects at an ordinary diſtance will fall before the retina; and therefore the picture muſt be confuſed on the retina itſelf. Whence, Secondly, in order to ſee diſtinctly, they are obliged to bring the object very nigh to their eyes; by which means the rays which are now more diverging, are made to converge and meet at the retina. Thirdly, the ſhort-ſighted never look attentively to thoſe who ſpeak to them, for by this defect in their ſight, they cannot exactly obſerve the motion of the eyes of thoſe who ſpeak, which contributes greatly to explain their thoughts. Fourthly, ſhort-ſighted perſons need leſs light for ſeeing clearly than others: for when the object is near more light enters the pupil, and acts more powerfully upon the retina than when it is at a greater diſtance. But beſides this in the myopia the pupil is very large, on which account more light will enter the eye. That the pupil is large in myopical eyes, is a common obſervation; nor will the reaſon thereof be difficult to any one who ſhall conſider that, The natural ſtate of the pupil is a ſtate of dilatation, as is manifeſt from its being very large in faintings, and upon firſt waking, as alſo after death. That the cauſe of the contraction of the

pupil

pupil lies in the mind. That when the ſight is perfect, and more eſpecially when weak, as in old men, all objects very near the eyes appear confuſed; on which account, as well as on account of the light which enters the eye, the pupil will be contracted: Whereas in ſhort-ſighted people near objects appear diſtinct, and therefore the pupil only contracts by reaſon of the too great quantity of light which enters the eye, which alſo they can eaſily avoid by retiring into a darker place: And this is one reaſon why the pupil, which in children is very large, always continues ſo in thoſe who are ſhort-ſighted, and who are not obliged to contract it for ſeeing more diſtinctly. But in the perfect ſight, and eſpecially in the viſus ſenilis, the pupil muſt become ſmaller by degrees; for by its frequent contraction for ſeeing near objects more diſtinctly, the orbicular fibres ſhrink and become ſhorter; by which means the pupil becomes narrower. Fifthly, Myopes have their ſight mended by concave glaſſes; for the refraction which is here too ſtrong, will be diminiſhed by the interpoſition of ſuch a glaſs: But as ſuch glaſſes repreſent objects under a leſs angle, they muſt appear leſs than to the naked eye. Sixthly, Their ſight will be mended by looking through a ſmall hole; for the luminous pencils which have for their apex a point in the object, and for their baſis the hole, will by reaſon of their acuteneſs take up ſo ſmall a ſpace on the retina, as to occaſion but little confuſion in the picture. Hence ſhort-ſighted people to ſee diſtant objects diſtinctly, ſhut their eye-lids, ſo as to leave open only a very ſmall ſlit, by which the confuſion in the picture is in ſome meaſure corrected. Seventhly, Short-ſighted perſons commonly become leſs ſo as they advance in years, becauſe the humours of the eye daily waſte and decay, the cornea ſhrinks and becomes leſs convex, and the cryſtalline flatter, by which means the rays of light are leſs refracted. Hence, young children never take notice of any thing but what is cloſe upon their eyes; for in them the cornea is too convex and prominent. This ſkilfull painters are well

 acquainted

acquainted with, who when they paint young children in profile give the cornea an uncommon convexity. Eighthly, Small lucid bodies, when at a conſiderable diſtance, appear great, round and frequently full of ſpots. For underſtanding this, let H (fig. 10.) be the eye, and let the candle *a* be the object, at the diſtance of ſixty feet, and which by reaſon of its diſtance may be conceived as a point. The rays of light A B, A C, &c. will, after refraction in this myopical eye, converge and meet in a point before the retina as at *o*, and after that they will diverge and form on the retina the large image *d e*, which will have the ſame figure with the pupil, and conſequently will be round. From the extreme points of this image *d* and *e* draw through the center of the eye L, the right lines *d* L D, *e* L E. Theſe lines will be perpendicular to the retina at the points *d* and *e*, and conſequently the object *a* will, by means of its luxuriant picture on the retina *d e*, be ſeen under the angle D L E. If therefore about the center A, with the radius A D, the circle A D E be deſcribed, the ſmall object A will be ſeen uniformly extended over all that circle. Hence 1ſt, when the ſmall object A is at a great diſtance, the appearance will be great. At ſixty feet diſtance a candle commonly appears a luminous circle of about a foot diameter, but this will be greater or ſmaller, according to the degree of ſhortneſs of ſight and magnitude of the pupil. Secondly, the nearer the object is, the appearance will be the leſs. Thirdly, when two or more candles of unequal magnitude are ſeen at a great diſtance, they appear equal, and if they are not far from one another, their circular appearances cut each other. Fourthly, if the hand be gently brought before the eye, before any one of theſe circular appearances are hid, ſome part of each circle will diſappear, and the part made to diſappear will lie on the ſame ſide with the interpoſed hand; whereas in the viſus ſenilis it lies on the oppoſite ſide, as will be ſeen below. Fifthly, the ſame cauſe which makes a candle at a diſtance appear larger than it is to a myops, makes the ſtars appear larger than they ought to us; for the eye with reſpect to them is purblind,

blind. When the fixed ſtars are viewed through a ſmall hole made in a card, they ſeem much leſs than when ſeen with the naked eye; for the luxuriancy of the image being in ſome meaſure corrected by the ſmallneſs of the hole in the card, the ſtars themſelves muſt neceſſarily appear ſmaller: And this alſo is one reaſon why the teleſcope, which increaſes the magnitude of all other objects, diminiſhes that of the ſtars; for this optical inſtrument does not here magnify ſo much by increaſing the angle under which they are ſeen, as it diminiſhes by uniting the rays at the retina, and by that means correcting the luxuriancy of the picture: Nor is it any ſolid objection to this, that the ſun and moon, with reſpect to the diſtance of both which no doubt the eye is alſo myopical, appear larger, when ſeen with a teleſcope than with the naked eye; for it muſt be obſerved, that at a given diſtance the luxuriancy in the image, proceeding from the rays not being accurately united at the retina, is always the ſame, and is not augmented according to the magnitude of the object; and therefore in large bodies, ſuch as the ſun and moon, it bears but a very ſmall proportion to the true magnitude of the image, and conſequently, when this luxuriancy is cut off by the teleſcope, it makes no ſenſible detraction from the magnitude which ariſes from the augmentation of the viſual angle. And of the ſame kind with this appearance of the ſtars, is alſo the appearance of a diſtant candle, which in the night-time ſeems larger than it ought to moſt eyes; becauſe the eye, with reſpect to its diſtance, is ſomewhat purblind, and the pupil being then much dilated, muſt greatly increaſe the luxuriancy of the picture: But if this ſame candle be viewed in day-light, or even if it be viewed by night from a well lighted room, or if a flaſh of lightning ſhould happen at the time it is viewed, it will not appear much bigger than it ought, by reaſon of the contraction of the pupil which corrects the luxuriancy of its picture on the retina. As for what concerns the ſpots which are ſo frequently obſerved by myopical eyes; theſe may proceed from ſome little extravaſations, varicous ſwellings, or other defects in the

the retina, which by intercepting the rays will occaſion a defect in the picture, and by conſequence a ſimilar and correſponding defect or ſpot in the object. Theſe ſpots commonly vaniſh, or at leaſt become leſs ſenſible, when the object is brought nearer the eye, and within the limits of diſtinct viſion; for the rays which are now exactly united upon the retina, by being more crowded have their force augmented; by which means a ſenſible impreſſion is made upon the retina through theſe extravaſations. Hence theſe ſpots are moſt ſenſible to thoſe who have a ſmall pupil, and eſpecially to thoſe who are ſhort or long ſighted. Hence alſo in a preſbytical eye the ſpots which were formerly very ſenſible, become faint, when the object is viewed through a convex glaſs; for by means of this glaſs more rays enter the eye, which being united exactly at its bottom, muſt ſtrike the retina ſtrongly enough to make a ſenſible impreſſion through theſe extravaſations, which will render the ſpots obſcure. And what has been ſaid with reſpect to theſe ſpots when occaſioned by extravaſations or other defects in the retina which intercept the rays, will alſo hold when they are occaſioned by a calloſity or any degree of paralyſis or inſenſibility in ſome parts of the retina, by which the impulſe received from the rays is made leſs ſenſible. But beſides theſe defects in the retina, there is yet another cauſe which may give occaſion to thoſe ſpots, both in the myopia and viſus ſenilis, and that is certain ſmall opaque marks in the cornea itſelf, or any where within the eye, which by intercepting ſome of the rays, muſt occaſion a defect in the picture, from which defect a kind of dark ſpot will be ſeen in the object. Thus in the eye of a myops (fig. 10.) if there is any opacity in the cornea or within the eye which intercepts the rays B *b* *c* C *c* *d* and V L *a*, there will be a defect in the picture at *e*, *d*, and *a*, from which alſo the external appearance will be deficient at the correſponding points E D and A, where by conſequence dark ſpots will be ſeen; for it is here to be obſerved, that there is not one point in

in the picture which is formed by a plurality of ray, which convene at that point, but every ray goes to a different point of the picture, both in myopical and presbytical eyes; and therefore when any of the rays are intercepted, that part of the picture to which such rays belong will not be illuminated, which must occasion a corresponding defect in the appearance of the object, but in the perfect sight where the rays which come from the several points of the object are so refracted as to meet again at so many corresponding points in the retina, every point of the picture is formed by a cone of rays, whose basis is the pupil; and therefore, though some of those rays be intercepted, yet no part of the picture will be darkened, and consequently no defect will be seen in the object from any such opacity in the cornea or humours of the eye, unless this opacity be in the back part of the vitreous humour, where the pencil is narrow, and intercepts the whole pencil. This may be proved in the camera obscura, by sticking some small patches on the glass, which will not be perceived if the paper is placed at the due focal distance, but if the distance be greater or smaller the spots will appear. And it is only from this principle, that any satisfactory account can be given how it comes to pass, that when an opaque body less than the pupil, is held close to the eye, before which several candles are placed at a great distance, if the eye attend to it, this object will be seen multiplied according to the number of candles, and will appear like a dark spot in each of them. This phænomenon admits of a most easy solution, for when the eye endeavours to see the small object, it becomes myopical with respect to the candles; and therefore on each of their pictures on the retina, the dark shade of the interposed body will be cast; from which a corresponding dark spot must be seen in each of the candles: But when the eye does not attend to this small body, but is well disposed for seeing the candles distinctly; this body will not be multiplied, nor will any spot be seen in any of the candles, because every point of their

their pictures is now composed of a cone of rays, which after refraction are made to convene at that point; and therefore, though some of the rays belonging to each pencil are intercepted, yet every point of the picture will be sufficiently and equally illuminated by the rays which are not intercepted; and consequently no defect will be seen in the candles, and the opaque body will seem diaphanous. Ninthly, Myopes read and write very small characters by reason that the visual angle is enlarged by the proximity of the object: Whence also great characters fatigue their eyes, because of the motion required to run over a word. Tenthly, In reading they hold the book towards the side of their head, that it may not be darkened by its shade. Eleventhly, No object being distinctly seen but what is very nigh, in order to see it with both eyes their axes must be very converging; which situation of their eyes being painful and laborious, because of the effort which must be exerted by the muscles, they are oftentimes obliged to turn away one of their eyes, whence proceeds a double vision, which frequently obliges them to shut one of their eyes. Twelfthly, Another phænomenon happens to all kinds of sight: An object is seen which is not looked at, and not seen when the eyes are turned towards it. Let A I K (fig. 11.) be the eye, B L a black body placed near it, O the object, *f c* the pupil turned towards M. The rays from O, in passing by B L, will fall on the cornea at A, and be refracted so as to pass through *f c* to the retina; by which means O will be seen, though the eye is not directed to it. But if, without moving the head, the eye be turned towards O, the rays from O, which pass B, can never, from the obliquity of their incidence, enter the pupil E D. Hence the object O will not be seen, when the eye is directed to it.

Presbytæ, or weak-sighted people, are such as have the cornea or crystalline too flat, in proportion to the distance betwixt the crystalline and retina. From which fault in the conformation of our eyes it follows, that, first the rays of light which come from the several

veral points of an object at an ordinary diſtance, for want of ſufficient refraction will not meet at the retina but beyond it: And therefore the picture on the retina will be imperfect and indiſtinct, more or leſs, according as the object is nearer or further off. Whence, ſecondly in order to read, they muſt remove the book to the diſtance of two or three feet; whereas, in their youth they uſed to read at one foot diſtance. But, thirdly, as the picture on the retina and the viſual angle under which the object is ſeen are then leſſened, and that in proportion as the diſtance of the object is increaſed; it is evident that ſmall obj cts will not be ſeen well even when their diſtance is ſuch as is neceſſary for making their picture on the retina diſtinct. Whence it is that ſometimes they cannot read at all, eſpecially if the characters are ſmall, without the aſſiſtance of ſpectacles; which are ſtill the more neceſſary, becauſe that when the object is at a diſtance, leſs light enters the eye, and conſequently the picture and impreſſion on the retina will be fainter. But for a fuller explication of this point, and to ſhew how ſmall objects may become inviſible to the naked eye, even when their picture is diſtinct upon the retina, it muſt be obſerved that there is a minimum viſible, and that all objects, however ſmall, if at all ſeen, are ſeen of that bigneſs. For the retina being compoſed of ſmall fibres, not unlike a piece of pluſh, with the ends of the fibres turned towards the cryſtalline, all the other ends of them being terminated in the brain, there can be no more diſtinct ſenſations than there are diſtinct threads to convey the impreſſion on them, and the eye will be incapable of diſtinguiſhing the parts of any picture which is no more than one of thoſe fibres compoſing the retina; ſo that if any object be ſo far removed from the eye, as to make the picture of it on the retina leſs than one ſingle fibre, that object becomes inviſible, if it be but of a dull radiation becauſe of the weakneſs of the impreſſion made on the fibre; but if it be of a very powerful and bright radiation, the whole filament is moved, by having one part of it

it powerfully acted on, and therefore this ſenſation is the ſame as if the object were much bigger, and took up or covered the whole end of the filament: And this to me ſeems to be the reaſon why the ſtars appear all of the ſame bigneſs, and why even to the naked eye they appear many thouſand times bigger than really they are, and even as big as through a long teleſcope, which would not be if our ſight was ſufficiently fine and nice. But there is yet another reaſon why an object is not ſeen when its picture is leſs than one ſingle fibre; and that is, that this ſame fibre not only receives an impreſſion from this object, but alſo an impreſſion from the extreme parts of the contiguous objects, which, if of a bright radiation, muſt prevail over the other impreſſion, and render the object itſelf inviſible: Thus if one of the fibres compoſing the retina be ſuppoſed as big as *a o* (fig. 12.) the ſmall object I E will on the retina make a picture betwixt *i* and *e*, and the contiguous objects O I and A E will on the ſame fibre *a o* form a picture at *o i* and *a e*, which being white will act more powerfully on the fibre *ao* than does the picture of the ſmall black object I E, and conſequently this ſame object I E muſt become inviſible, and the more bright and luminous bodies O I and A E muſt appear extended over all the ſpace O I E A. Dr. Hook found the minimum viſibile in moſt eyes to be comprehended within an angle of one minute (a). Hence whatever is ſeen, is ſeen of that bigneſs, or within that angle: Thus every ſtar which the eye diſcovers, appears to be of the bigneſs of a minute at leaſt and ſo it is conceived really to be; though when we come to examine its diameter by a teleſcope, we find it but ſome few ſeconds, or ſixtieth parts of ſuch an angle: And this alſo is the reaſon why, if there be two, three, or a hundred ſmall ſtars ſo near together as they are all compriſed within the angle of one minute, the eye has a ſenſation of them all as if they were one ſtar, and diſtinguiſhes them not from one another, becauſe all their pictures falling upon the

(a) See his poſthumous works p. 12 and 97.

ſame

ſame nervous fibre make but one impreſſion on the ſenſorium; which being ſtrong and powerful, prevails over and deſtroys the faint impreſſion made by the picture of the interval which is betwixt them. This experiment of Hook's affords us a pretty certain proof of the magnitude of our nervous fevers: For if *a o* (fig. 12.) be the end of one ſingle fibre, the ſmall object A E, which is here ſuppoſed to be bright and luminous, will by means of its picture on the retina *i e*, move the whole fibre, and the appearance of the object will be the ſame as if its picture was extended over the whole end of the fibre *a o*; and therefore, if from the extreme points of the fibre *a* and *o*, the right lines *a x* A, *o x* O are drawn through the center of the eye *x*, theſe lines will be perpendicular to the retina, at the points *a* and *o*, and conſequently the ſmall object I E will be ſeen under the angle O *x* A, which angle being given, the angle *o x a* which is equal to it (both being angles at the vertex *x*) will alſo be known, from which the diameter of the nervous fibre *ao* may eaſily be found. Thus if the angle O *x* A be one minute, as Dr. Hook found it in moſt eyes, though there were ſome who could ſee to the third of a minute, the angle *o x a* will alſo be one minute, which is the ſixtieth part of a degree, or the 21,600 part of a circle: Whence if the eye be ſuppoſed to be one inch diameter, the diameter of the nervous fibre *a o* will be the 21,600 part of three inches, or the 600 part of a line, and the 3,600 part of an ordinary hair: And if it be ſuppoſed that one can ſee under an angle no bigger than the third part of a minute, as Hook found that ſome could do, then the bigneſs of the nervous fibres compoſing the retina will not exceed the 32,400 part of an ordinary hair. But this is not all; for if birds can ſee diſtant objects as well as man, it is neceſſary that the fibres which compoſe their optic nerves and retina be much more fine; for ſince their eyes are ſmaller than ours, the image of objects on the retina will alſo be ſmaller: Whence it is manifeſt that a ſimilar conformation of the humours is not alone ſuf-

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ficient to make an equal perfection in the sight: For instance, an eye of two lines diameter (than which there are many smaller) which has the humours of a similar figure to those of a human eye, whose diameter is an inch can never see objects at a great distance as distinctly as we do, unless the retina be thirty-six times finer and more sensible than it is in our eyes, for the picture of the object will be thirty-six times smaller in their eye than in ours, the surfaces of the globes of their eyes being to one another as one to 36. And therefore if the fibres of our retina exceed not the 32,400 part of a hair, theirs will be no bigger than the 1,166,400 part of a hair, which is a prodigiously surprising and almost incredible smallness; and yet it is as certain as any proposition in Euclid that they can be no bigger, if we allow them to see objects at a distance as distinctly as men do. But I must go forward. Fourthly, They who are long-sighted require more light than others for enabling them to read, for being obliged to remove the book to a considerable distance, less light will enter the eye, and the impression made thereby on the retina will be too faint, unless the object be strongly illuminated. Fifthly, The presbytical eye receives greater benefit from the use of a convex lens, than the eye of a myops from one that is concave; for the property of the first glasses being to collect the rays, more of them will be made to enter the pupil; and as in such eyes the refraction is too weak, the rays which flow from a point at an ordinary distance, and which for want of sufficient refraction do not concur at the retina, will by means of this glass be made to meet at the retina, whence the long-sighted receive a double advantage from convex glasses; for by them the picture is not only distinct upon the retina, but is also as strong and lively as if the pupil had been much larger. Sixthly, The long-sighted see more distinctly through a small hole, for the same reason that myopes do; but as part of the light is thus intercepted, the long-sighted will not reap so much advantage from it as the short-sighted. Seventhly, The

the long-ſighted commonly become more ſo as they advance in years; for the cornea and cryſtalline become flatter continually becauſe of the daily waſte and decay which happens in the humours of the eye; whence at laſt they cannot ſee at all without the aſſiſtances of ſpectacles which ſupply the refraction wanting, by rendering the rays converging, which can never be done by the poſition of the object alone from which they proceed: For if it is near, they enter the eye diverging; and if it is far off, they enter nearly parallel; but though the preſbytical eye commonly becomes more ſo by degrees, yet ſome have at laſt recovered their ſight again. There are many cauſes which may produce this effect; but it is probable that it chiefly ariſes from a decay of the fat in the bottom of the orbit, whence the eye for want of the uſual reſiſtance at its fund, is, by the preſſure of the muſcles and fat towards the ſides of the eye, reduced to an oblong figure, by which the retina is removed to a due focal diſtance from the cryſtalline. From this it is eaſy to ſee, how from a contrary cauſe the ſight, which was perfect till the 20th or 25th year of their age, does in ſome for a certain time after that become more myopical by degrees: for if at this time the muſcles of the eye become bigger, or if the fat ſhould be collected in greater plenty towards the ſide of the eye, the eye will, by reaſon of the preſſure on its ſides, be reduced to an oblong figure, and the retina will be puſhed back to too great a diſtance from the cryſtalline, which obliges them to bring the object they would ſee diſtinctly nearer to their eyes than they uſed to do. Eighthly, in the preſbytical ſight, the eye ſuffers more by great light than when the ſight is either perfect or myopical with the ſame opening of the pupil; for the luminous bodies which ſurround us, and which are not very near us, ſends rays into the eye, which in the perfect ſight are united upon the retina, and make but a ſmall baſe in the preſbytical eye; whence the impreſſion will be ſtrong and lively in both theſe eyes, and muſt therein cauſe ſome uneaſineſs, which does not

happen in the myopical ſight, becauſe theſe rays make a large baſe on the retina; for all things being equal, the myopical eye always ſees objects more confuſedly than the preſbytical eye, and this confuſion is cauſed by the ſpace which the rays that come from each point of the object, occupy on the fund of the eye. And this is another reaſon why the pupil which in children is very large, continues more ſo in thoſe who are ſhort-ſighted, than in either the perfect or weak ſighted. Ninthly, to a preſbytical eye, ſmall lucid objects appear big and round; and if the rays on either ſide of the pupil be intercepted by any opaque body, the oppoſite ſide of the appearance will be hid, and the opaque body itſelf will appear as if it were on the contrary ſide to that where it really is. For explaining this phænomenon (fig. 13.) where the candle A is the ſmall luminous object, B C *d c* the eye, and *a* the point of concourſe, where the rays A B, A C, &c. which come from the point A, are united behind the retina; theſe rays being cut by the retina before their re-union, will therefore form the large image *e d*, which by reaſon of the round figure of the pupil, will alſo be round, whence the candle itſelf will likewiſe appear round, and of a bigneſs anſwerable to the bigneſs of its luxuriant image; for by means of the impreſſion at *e*, it will be ſeen at E in the right line *e x* E, which being drawn through the center of the eye *x*, is perpendicular to the retina at the point *e*, and by means of the impreſſion at *d*, it will be ſeen at D in the right line *d x* D; which being drawn through the center of the eye *x* is alſo perpendicular to the retina at the point *d*; and by means of the other impreſſions made by the other rays forming the circular picture *e d*, it will be ſeen in the other points of the circle A E D deſcribed about the center A with the radius A D, and conſequently will appear big and round; and if by the interpoſition of the opaque body F, the ray A C be intercepted, there will be a defect in the picture at *d*, and conſequently a ſimilar defect in the appearance at D; and therefore if this ſame body F be ſlowly moved

moved from C to *f*, this defect in the picture will gradually extend itself from *d* to *o*, by which a similar defect in the appearance will extend itself from D to A; insomuch that when the extremity of the opaque body F has by moving from C to *f*, come to *f*, the half of the picture at *d o*, and the corresponding half of the appearance D A will vanish, and the candle have a semicircular appearance at A E. Whence F must appear on the contrary side to that where it really is. Tenthly, the last phænomenon I shall take notice of is the little spots or marks which long-sighted people are apt to see before their eyes. I have already enquired into the cause of these spots, and have shewn that when the eye sees distinctly no spots will appear, unless there be some defect in the retina itself; but in the short and long sight, certain dark spots will also be seen, when there are any small opaque marks on the cornea or any where within the eye, which intercept some of the rays in their passage to the retina; which does not commonly happen when the eye sees distinctly, because then the rays which come from a point in the object are exactly united in a point in the retina; and therefore though some of them be intercepted, yet that point will be seen by means of those which pass; yet if any such opaque spot be in the back-part of the vitreous humour where the pencil is narrow, and intercept the whole pencil, the corresponding point of the object will be darkened. These spots are not all of the same kind, there are some which change not their place with respect to the axis of vision; and these proceed from some defect either in the retina or cornea, or in the vitreous and crystalline humours. Others are in constant motion, and change their place continually, and these must arise from some corpuscles floating in the aqueous humour; but whether they are fixed or moving, they must always appear like dark marks in the object. And this leads me to explain another kind of spots, which are common in the presbytical sight, and which are not dark or shady, like those which have been already accounted for, but more bright and luminous than the

object itſelf before which they appear. Theſe ſpots appear beſt in looking to bright objects at a conſiderable diſtance, and are always of the ſame colour with the object. In the middle their colour is clear and ſtrong, ſurrounded by a dark and ſhady border. They are commonly accompanied with certain irregular veins, which proceed from each ſpot, and which, as well as the ſpots themſelves, change their order and diſpoſition. Theſe veins are alſo of the ſame colour with the object, and being bright and luminous in the middle, are likewiſe terminated by a dark and obſcure edge, as may be ſeen at fig. 14. Theſe ſpots change their poſition with reſpect to the axis of viſion, according as the eye is differently moved, being ſometimes in the axis of viſion itſelf, and at other times to the right or left of this ſame axis; but when the eye is kept fixt in the ſame direction, they commonly deſcend gradually. As for what concerns the cauſe of theſe ſpots and veins, it ſeems evident, that firſt, they muſt proceed from ſome corpuſcles within the eye, which are at liberty to change their place, and which therefore muſt be ſuppoſed to float in the aqueous humour. Secondly, ſeeing theſe ſpots always deſcend when the eye is kept fixed, the corpuſcles from which they ariſe muſt aſcend, and conſequently are lighter than the aqueous humour in which they ſwim. Thirdly, theſe ſpots being more bright and luminous than the object, they cannot be occaſioned by any opaque corpuſcles, which by intercepting the rays caſt a ſhade upon the retina. For from ſuch corpuſcles the ſpots would appear like defects or dark marks on the object, as has been ſhewn above. What therefore bids faireſt for producing theſe ſpots and veins is ſmall, oily, diaphanous particles and filaments which ſwim in the aqueous humour before the cryſtalline, for ſuch, by their lightneſs, will aſcend, when left to themſelves, and by their greater refractive power, produce theſe luminous ſpots terminated by dark bodies. That oily and ſulphureous ſubſtances, though leſs denſe than water, have a ſtronger refractive power, is evident from the obſerva-

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tions of Sir Iſaac Newton. From which it follows, that the rays of light, which paſs through theſe oily particles, will meet ſooner behind the cryſtalline, than the other rays: Whence in the preſbytical eye, the rays of light which come from the ſeveral points of the object, will not converge to ſo many other points in the retina, but behind it, by which the picture on the retina, will be rendered more dark and obſcure; but the rays which paſs through theſe oily grains, by having their refraction increaſed, will meet nearly at the retina, where they will form ſmall luminous ſpots and veins, ſurrounded with dark borders; juſt as a convex glaſs when expoſed to the ſun, forms its luminous focus in the middle of a very ſtrong ſhade. For as light is not generated whenever we ſee it increaſed, it is by robbing ſome other part of its light, or by bringing the light which ſhould have been diffuſed over ſome other part to the more enlightened place. When therefore the rays of light which paſs through theſe oily particles are ſo refracted as to convene at the retina, and paint thereon ſmall luminous ſpots and veins, theſe ſpots and veins will be terminated by a dark and a ſhady edge, becauſe the light which ſhould have illuminated the edge is now made to fall on the luminous picture: And thus in the preſbytical eye, ſmall luminous ſpots and veins, encompaſſed with dark and ſhady borders, may be painted on the retina, and how from ſuch pictures, ſimilar and like ſpots and veins will be ſeen moving before the object.

From what has been ſaid concerning the phænomena peculiar to the ſhort and long-ſight, may be deduced the many advantages that accrue to us from the motion of the cryſtalline humour; for by this motion our eyes are fitted for ſeeing diſtinctly at different diſtances: Had we been denied the power of changing its ſituation, there could have been no diſtinct viſion, but at one determined diſtance of our eyes; and with reſpect to all objects at a greater or leſſer diſtance, the ſight would have been myopical or preſbytical, and

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consequently liable to all the symptoms, defects, and inconveniences above explained.

Secondly, besides the advantage we receive from the mobility of the crystalline in enabling us to see distinctly at different distances, there is another taken notice of by most optical writers, which consists in enabling us to judge with more certainty of the distance of objects. There are six things whereby we are enabled to discover the distance of objects. The first mean consists in that disposition of the eye which is necessary for seeing distinctly at different distances. We have demonstrated that there can be no distinct vision unless the rays of light, sent from the several points of the object, be brought together in so many corresponding points on the retina; and that the same conformation in the eye is not able to perform this effect, but must be changed by the contraction of the ligamentum ciliare, which being sensible to us, because it depends on our mind which regulates it, will enable us in some measure to judge of distances even with one eye. But as this change in the conformation of the eye has its limits, it can be of no use in assisting us to judge of the distance of objects placed without the limits of distinct vision: But as the object appears more or less confused as it is more or less removed from these limits, this confusion supplies the place of the motion of the crystalline in aiding the mind to judge of the distance of the object, it being always esteemed so much the nearer or further off by how much the confusion is greater: But this confusion has its limits also; for when an object is placed at a certain distance from the eye, to which the breadth of the pupil bears no sensible proportion, the rays of light which come from a point in the object and pass the pupil, are so little diverging, that they may in a physical sense be looked on as parallel; and therefore the picture on the retina will not to sense become more confused, though the object be removed to a much greater distance. What this distance is, to which the diameter of the pupil bears no sensible proportion, is not determined;

termined; but considering the smallness of the pupil, it cannot reach any great way, and consequently this confusion in the appearance of objects can only assist us in judging of small distances. The second, most universal, and frequently most sure mean, we have for judging of the distance of objects in the angle made by the optic axes at that part of the object on which our eyes are fixed: And this is the reason why those who are blind of one eye frequently miss the mark in pouring liquor into a glass, and such other actions which require that the distance be exactly distinguished. The third mean for judging of the distance of objects, consists in their apparent magnitudes, or the magnitude of their image painted on the retina. The diameter of these images always diminishes in proportion as the distance of the object increases; and therefore from this change in the magnitude of the image, we may easily judge of the distance of objects, as often as we are otherwise acquainted with the magnitude of the objects themselves. Hence painters diminish the magnitude of objects in their pictures, in proportion as they would have them appear at a greater distance. But as oft as we are ignorant of the real magnitude of bodies, we can never from their apparent magnitude form any judgment of their distance. The fourth thing whereby we judge of the distance of objects is the force wherewith their colour acts upon their eyes: for if we are assured that two objects are of a similar colour, and the one appears more bright than the other, we judge the brightest object to be the nearest. It is the opinion of some that the force wherewith the colour of objects strikes our eyes, decreases in a reciprocal duplicate proportion of their distances, because the intensity of light always decreases in that proportion. This is true with regard to light; for since the light is diffused like rays drawn from the center to the circumference, its intensity at any given distance from its center of activity will be proportional to the density of its rays at that distance; and therefore, if A, (fig. 15.) be any radiant or visible point, and if ABE, ACF, ADG, &c. represent the rays flow-

ing ſpherically therefrom, the rays, which, at the diſtance A B, are diffuſed through the ſpherical ſurface BCD, at the diſtance of A E, are diſperſed through the whole ſpherical ſurface E F G; but the denſity of any given quantity of rays is reciprocally as the ſpaces they occupy, that is, if the ſurface E F G be double the ſurface B C D, the rays at the ſurface B C D will be twice as thick, or denſe as the ſame rays at the ſurface EFG; and if the Surface EFG be triple the ſurface B C D, the rays at B C D will alſo be three times denſer than the ſame rays at the ſurface E F G and univerſally, whatever proportion the ſurface E F G; has to the ſurface B C D, the ſame proportion will reciprocally obtain betwixt the denſity of the rays at the ſurface B C D and the ſurface E F G: But (as is manifeſt from Archimedes de ſphera & cylindro) the ſurfaces of ſpheres are in a duplicate proportion of their diameters or radii; and therefore the thickneſs or denſity of the rays, at the diſtance A B, is to their denſity at the diſtance AE, in a reciprocal duplicate proportion of the ſemidiameter or diſtance A E to the ſemidiameter or diſtance A B: But as has been already ſaid, the vigour or intenſity of light, in any given diſtance, is always as the denſity of its rays at that diſtance; and therefore the intenſity of light at any diſtance as AB, will be to its intenſeneſs at any other diſtance, as AE, in a reciprocal duplicate proportion of the diſtance A E to the diſtance AB; that is, as the ſquare of AE is to the ſquare of AB. But, though the intenſity of light decreaſes in a reciprocal duplicate proportion of the diſtances from the radiant, it follows not, that the force wherewith objects act upon our ſight decreaſes in the ſame proportion, and that for this obvious reaſon, viz. that as the intenſity of light decreaſes by the diſtance of the object, ſo the magnitude of the image on the retina decreaſes alſo in the ſame proportion; and therefore this image will be as ſtrong and lively when the object is at a diſtance as when it is near, and conſequently the object will at all diſtances appear equally ſtrong, clear, luminous, unleſs ſome other cauſe make it otherwiſe. For underſtanding what this cauſe is, let into a darkened room

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through a ſmall hole a beam of the ſun's light; this beam being ſeen like a luminous path in all poſitions of the eye, it is evident that the whole light goes not forward in its rectilinear courſe, but that at all points of the medium through which it paſſes, ſome part of it is reflected every way, by means of which the beam becomes viſible; and therefore this ſame beam by the continual diminution made in its light, muſt grow weaker and weaker continually, and that in proportion to the opacity of the medium through which it paſſes. If the air be pure and clear, little light will be refracted and more will be tranſmitted. If it be moiſt or ſmoaky, more will be reflected, and leſs tranſmitted. But be it ever ſo clear, ſome part of the light will always be reflected or ſtifled in its paſſage; and conſequently its intenſity muſt always increaſe in proportion to the diſtance of the object from which it flows. Seeing then the intenſity and vigour of light thus continually decreaſes, according as the diſtance of the object increaſes; it follows that objects muſt always appear leſs luminous, and more tinged with the colour of the medium through which they are ſeen, the further they are removed from our eyes; and therefore, when we are otherwiſe aſſured that two objects are of the ſame colour, if the one appear more bright and lively than the other, we are taught by experience to conclude that that which appears moſt bright is the neareſt; and for this reaſon ſtrongly illuminated bodies always appear nearer than really they are. Whence a chamber appears leſs when its walls are whitened; for in this and ſuch like caſes, the brightneſs and ſtrength of colour makes them ſeem nearer, from which we conclude they are ſmaller; for we always judge of the extenſion and magnitude of bodies, by comparing their apparent magnitude with their diſtance. Hence alſo fire and flame appear ſmall when ſeen at a diſtance in the night time, for the pupil being then much dilated, more light will enter the eye, which by acting more powerfully on the retina, muſt make the object appear much nearer, from which it will be judged ſmaller. And as bright and

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luminous bodies appear nearer and leſs than they really are, ſo on the contrary dark objects and objects faintly illuminated always appear further off and greater. This is particularly obſervable when dark bodies are ſeen in the twilight, which always ſeem further off and greater than when ſeen in the bright light of the day. For the like reaſon, the apparent diſtance and magnitude of objects are increaſed in miſty weather; for much light being intercepted or ſcattered irregularly in its paſſage through the miſt, leſs of it will enter the pupil, and conſequently it will act leſs forcibly on the retina, from which the object will be eſteemed at a greater diſtance and bigger than it ought. And this opacity of the atmoſphere, which hinders part of the light from coming to the eye, is alſo the reaſon why the ſun, moon and ſtars appear faint when near the horizon, and brighter as they riſe higher: For the tract of air and vapours which lies in the way of the rays, is longeſt and thickeſt near the horizon, and becomes thinner and ſhorter as the objects riſe higher: And this ſeems to be one reaſon why theſe bodies appear always the bigger the nearer they are to the horizon: For ſince they appear fainter, they will alſo appear at a greater diſtance, from which they muſt appear bigger, for the ſame reaſon that objects appear ſo in miſty weather. From all which I think we may ſafely conclude, that the apparent colours of bodies are very uſeful for us for judging of their diſtances, as often as we are otherwiſe well acquainted with the intenſity and vigour of their colour at any other determined diſtance. And it is from this principle that ſkilful painters repreſent objects on the ſame plane at different diſtances by increaſing or diminiſhing the intenſeneſs of the colour. It is indeed true that the pupil, by its contractile power, always proportions itſelf, as much as poſſible, to the ſtrength of light; from which ſome may think it ſhould be impoſſible for us to judge of the diſtance of objects from their apparent colour, or the force wherewith they act upon our eyes. But as the motion of the pupil muſt always be ſenſible to us; and therefore though the pupil ſhould by its contraction allow

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no more light to paſs to the retina, when the object is near than when it is further off, yet we are very ſenſible of the intenſeneſs of its light becauſe we know that the pupil is then contracted. And beſides, when the pupil is contracted, we ſee more diſtinctly than when it is dilated, by which alſo we are aſſiſted in judging of the diſtance of objects. The fifth mean for judging of the diſtances of objects conſiſts in the different appearance of their ſmall parts; when theſe parts appear diſtinct, we judge the object near; but when they appear confuſed, or diſappear, that it is at a greater diſtance. For the diameter of the images always diminiſh as the diſtance of the objects increaſes; and therefore any object may be made to vaniſh, by placing it at ſuch a diſtance from our eyes, as to make its picture inſenſible becauſe of its ſmallneſs; but the ſmaller the object the ſooner it vaniſhes. Hence, all the ſmall parts of an object are not ſeen at every diſtance; for the leaſt viſible part will always be ſmaller or greater as the object itſelf is nearer or further off. Thus the leaſt viſible part at one foot, will vaniſh at two feet diſtance. Therefore when the eye can ſee diſtinctly the ſmall parts of the object, it muſt judge that object to be nearer than any other, whoſe equal parts are not at all ſeen, or only ſeen confuſedly. Hence painters to repreſent objects at different diſtances on the ſame plane, paint them diſtinct or confuſed, as they would make them appear nearer or farther off. The ſixth and laſt mean for judging of the diſtance of objects, is, that the eye does not repreſent to our eye one object alone, but at the ſame time all thoſe betwixt us and the principal object; as for inſtance, when we look at any diſtant object, ſuch as a ſteeple, we commonly ſee at the ſame time ſeveral fields and houſes betwixt us and it; and therefore becauſe we judge of the diſtance of theſe fields and houſes, and at the ſame time ſee the ſteeple beyond them, we conclude that it is removed to a greater diſtance, and even that it is every way larger than when ſeen alone; and yet the image thereof is the ſame in both caſes, provided it be ſeen from a place equally diſtant. And

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this affords us another reaſon why the moon appears greater when ſhe riſes, than afterwards; for when ſhe riſes, by reaſon of the interpoſition of the fields, ſhe appears removed to the diſtance of ſeveral leagues, viz. beyond the ſenſible horizon; whereas at a greater height no body being interpoſed betwixt her and us, we don't judge her above half a league diſtant. There are then ſix means which ſerve our ſight for judging of the diſtance of objects, viz. Their apparent magnitude, the vivacity of their colour, the diſtinction of their ſmaller parts, the neceſſary conformation of the eyes for ſeeing diſtinctly at different diſtances, the direction of their axes, and the interpoſition of other objects betwixt us and the principal object. Of theſe ſix, painters can only make uſe of the three firſt in their pictures. But in theatres all ſix are conjoined, which if artfully managed, cannot fail of deceiving the eye. And what contributes further to the perfection of the cheat, is the falſe light wherewith theſe decorations are always illuminated. Having now finiſhed what concerns the motion of our cryſtalline, whereby the eye is adapted to the various diſtances of objects, it may not be improper, before I diſmiſs this ſubject, to explain a little another motion of the cryſtalline, which only obtains in birds, and is performed by means of the marſupium nigrum, black purſe, or bourſe noire as the French call it. This is a membrane in form of a purſe which ariſes from the entry of the optic nerve, and paſſes through the vitreous humour to its inſertion in that part of the edge of the cryſtalline, which is next the great canthus. Thus it is deſcribed by the French academiſts, and by Perrault (a), from whom I have copied it at fig. 16. which repreſents half of the globe of an oſtrich's eye, in which A is the cryſtalline humour, B the optic nerve, and C the black purſe attached above to the cryſtalline, and below to the optic nerve. But in ſome birds I have found this membrane of a rhomboidal figure, agreeable to the account given of it by Petit (a).

(a) Mechanique des animaux.

tit (a). It is always covered with a black pigment of a more intenſe colour than that of the uvea or choroides, whence Mr. Perrault and the French academiſts conjecture that its only uſe is to aſſiſt the choroides and uvea in preparing the nouriſhment of the humours of the eye, which by reaſon of the tranſparent purity requiſite for them, muſt have an aliment pure and exempt from the groſs, earthy and black parts, by which bodies are rendered opaque; for theſe parts, which may be called the lees of the blood, are ſeparated therefrom, and retained in the choroides and purſe of the optic nerve, which are ſullied and blackened therewith. I know that the uſe of this blackneſs in the uvea and choroides is ſeldom extended to the preſervation of this tranſparency in the humours of the eye; for moſt authors ſuppoſe that the blackneſs of the uvea ſerves only for rendering it more opaque, that no light may enter the eye but what paſſes the pupil, and that the blackneſs of the choroides has no other uſe than to ſtifle the rays of light which fall thereon. But if we conſider that the back-ſide of the choroides next to the ſcleroticais likewiſe covered with this black pigment, and that in all animals, even thoſe which have its concave next the retina (b) of another colour, we cannot but think that it likewiſe contributes to the preſervation of that tranſparency in the humours neceſſary for the tranſmiſſion of light; and that becauſe there appears no other reaſon for the black colour upon the back-ſide of the choroides: Thus the lion, and other quadrupeds, and even ſome of the bird kind which are not endowed with a good ſight, ſuch as the owl, and other nocturnal birds, which have the inſide of the choroides of a blue, green, yellow, pearl, or other bright and reſplendent colour, are never found to want a conſiderable quantity of this black mucous pigment on the back-ſide of this membrane, which can ſerve for nothing elſe but for freeing the aliment which goes to the cryſtalline and other humours of the eye from the black parts

(a) Mem. de l'Acad. Roy. an. 1726. (b) Aquapend. de ocul. §. 1. cap. 4.

which might render them unfit for tranſmitting the light. It therefore ſeems neceſſary that this tumour ſhould be provided with glands proper for ſecerning this black mucus, that the cornea and humours of the eye may not be tinged with any opacity; which they ſoon would do, were it not for the ſecretory power of the uvea and choroides, by which the blood which goes to their nouriſhment, is freed from its moſt opaque and black parts. Whence animals whoſe blood abounds moſt with blackiſh particles, have this membrane proportionally more intenſely black; for thoſe who have moſt blackneſs in their hair or feathers have this membrane alſo moſt black. There is a mechaniſm not unlike this in the cuttle-fiſh: This animal is provided with a bag, towards the throat, near the ſtomach, whoſe uſe is to ſeparate and contain all the black opaque particles of its blood and humours; hence it is that the ſubſtance of this fiſh is of a white colour, which otherwiſe probably would have been black: For the humour contained in this bag is ſo very black, that it exceeds even that of ink itſelf. Now as thn ſubſtance of this becomes white, from the ſeparatioe of all the opaque black particles contained in its blood and humours; ſo it is more than probable that the cornea and humours of the eye retain their tranſparency, becauſe the blood which goes to their nouriſhment is, by the ſecretory power of the choroides and uvea, freed of all thoſe opaque black particles which could in the leaſt diminiſh their pure tranſparency. And this may poſſibly be one reaſon why thoſe creatures which ſee beſt, ſuch as eagles, and other birds of prey, have the pupil very black; and on the contrary, the owl, lion, and other animals, whoſe ſight is not ſo good, have this hole leſs black. This much being premiſed concerning the uſe of the choroides and uvea, it will not be queſtioned but the black purſe has a ſimilar office; and that for theſe reaſons, Firſt, becauſe this membrane is never found in any other creature but birds, and that becauſe of all other creatures they have occaſion for the beſt ſight: Secondly, becauſe as birds fly more high, and by that means require a more

biercing

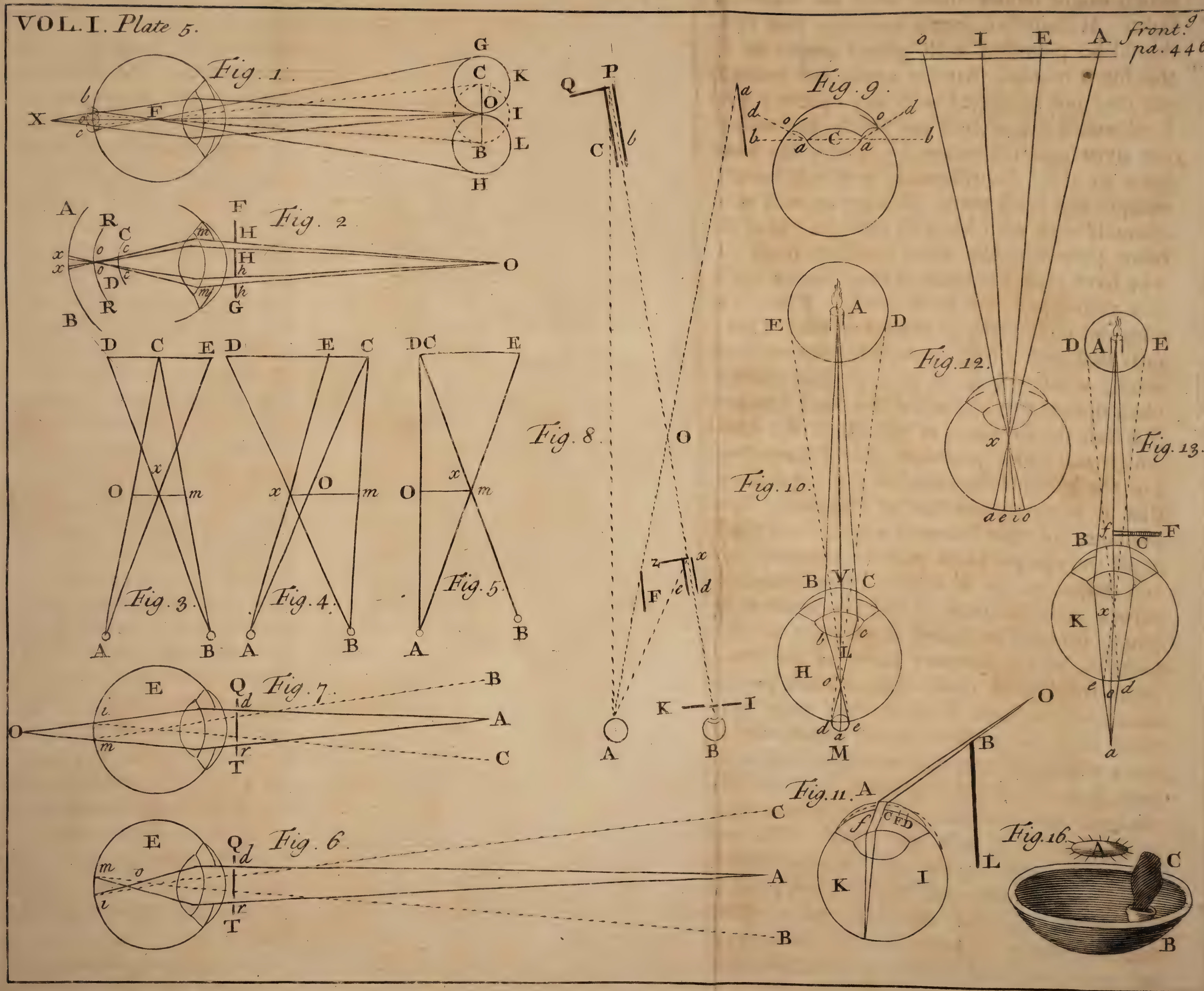
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Fig. 1.
Fig. 2
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 10.
Fig. 11.
Fig. 12.
Fig. 13.
Fig. 16.

piercing ſight, this part is always proportionally of a more intenſe black colour. Thirdly, becauſe in the Demoiſelle of Numidia, which is the only bird wherein the academiſts found this black purſe wanting, the choroides is a great deal blacker and thicker than ordinary, as if the whole dregs of the blood, which in the eyes of other birds ſhould be retained in the choroides and black purſe, had here been collected into the choroides alone. Theſe are the reaſons which determine us to agree with Perrault and the academiſts in thinking that the uſe of this part is to preſerve that tranſparency in the humours of the eye ſo neceſſary for viſion, though at the ſame time we are of opinion, that it has yet another uſe, no leſs conſiderable. The eyes of birds are placed ſo much towards the ſides of their head, as makes it impoſſible for them to direct both of them to the ſame object, though ſtraight before them. Hence when a bird wants to ſee an object which is ſtraight before it, it turns the ſide of its head that way, that the rays of light may fall directly upon its eye ; but then their ſight muſt be weaker, becauſe the object is only ſeen with one eye. Now this being underſtood, it is eaſy to ſee that without this black purſe, it would have been impoſſible for birds to ſee their food, becauſe the rays of light which come from an object placed near the extremity of their bill, would, in falling obliquely upon their eyes have, rendered their ſight prodigiouſly confuſed and imperfect, juſt as the image of a candle is confuſed when made by a lens placed obliquely ; and therefore to prevent this defect in the ſight of birds nature has provided them with this part, which being of a muſcular ſubſtance, draes by its contraction that edge of the cryſtalline next the great canthus towards the bottom of the eye, and renders its ſituation ſuch as the rays of light which come from objects placed directly before them, and towards the extremity of their bill, may fall upon it more perpendicularly, which was abſolutely neceſſary for diſtinct viſion : To confirm this opinion, it may be worth while to obſerve that this black purſe, if waſhed, appears to be compoſed of muſcular

muſcular fibres, not unlike the ligamentum ciliare. Nor is it any ſolid objection to this, ſuppoſing that this membrane ſhould not always be found inſerted into the cryſtalline; for it being ſo firmly fixed unto the vitreous humour, that the vitreous humour hangs firmly to it, and is not ſo eaſily parted from it, all the motions of this membrane are eaſily communicated to the vitreous humour, and by conſequence to the cryſtalline which is connected to it.

Practical remarks on the ſympathy of the parts of the body; by the late Dr. JAMES CRAWFORD, *Profeſſor of medicine in the Univerſity of Edinburgh.* Vol. 5. art. 45.

AN exact knowledge of the ſtructure and œconomy of the human body and of the influence which the parts have on one another, is the foundation of medicine; for if the proper and peculiar function of each particular part, and the connexion and influence which every one has on another is known, the effects which will ariſe in every part upon the application of any known cauſe to any particular part may be determined, and the ſeat of the cauſe which produced them, however remote, traced. This knowledge diſtinguiſhes the rational phyſician from the empyrick, and teaches the one to apply his remedies properly, while the other for want of it runs many hazards of doing harm rather than good.

In outward diſeaſes, though we are not ſo liable to miſtake their ſeat, or the proper place to apply the remedy; yet oftentimes the effects appear in one place, when the ſource lies in another; for diſtinct and remote parts communicating with one another by the intervention of long nerves and muſcles, a part really whole and ſound may be pained, and loſe its motion, from the influence of another in which no fault appears.

For penetrating therefore into the diſtant and latent ſources of ſuch diſeaſes, we muſt be well acquainted with the origin, the courſe, inſertion and motion

motion of every muſcle, and with the origin, diſtribution and communication of the nerves which belong to every part. I ſhall confirm and illuſtrate what I have hinted at by ſome caſes which may ſerve as a foundation for others of the ſame kind, and explain many ſtrange phænomena in outward diſeaſes, hitherto little taken notice of; but I ſhall premiſe.

1. That a part is affected by protopathia, when it is eſſentially in itſelf injured, and owes not the origin of its diſorder to any communication from another part.

Or by idiopathia, when though it be eſſentially injured yet the hurt was at firſt propagated to it from ſome other part.

Or laſtly by ſympathy or conſent, when the part is yet whole and ſound, and is only affected by the fault of ſome other part.

2. Diſeaſes by conſent are propagated from a diſtance (in which caſe only I ſhall conſider them) either by muſcles or nerves.

3. If by nerves, the effect is produced by a hurt at their origin, at ſome ganglion, or in ſome other branch of the ſame trunk which goes to ſome other muſcle, or perhaps of the nerve in a diſtant part of the ſame muſcle.

4. If by a muſcle, it muſt be hurt either in its origin or ſome diſtant part of its courſe; for wherever it be, the effect will be moſt manifeſt about the joint and inſertion, the tendon being the moſt ſenſible part, the pain is moſt felt there, and the contraction or relaxation appears about the joint.

5. If by both the muſcles and nerves, the vitium is as well propagated backwards from the inſertion to the origin, as forward from the origin to the inſertion.

6. A joint or member may continue contracted either by the flexors being in a ſpaſmodic contraction, or by the paralytic diſpoſition or debility of the extenſors; in which caſe the member is eaſily and without pain extended by another, if an anchyloſis has not happened.

7. For determining whether the fault ariſes from the muſcle or the nerve, examine if there be a wound,

an ulcer, a contuſion or tumor about either of their origins or courſes; if nothing appears, obſerve if this is the only muſcle affected; if ſo, the cauſe is in the muſcle, for ſuch a hidden fault in a muſcle is ſeldom propagated to another, except it have a large aponeuroſis, or confound its tendon with ſome other. But if the nerve is affected it communicates the ſame effect to all the other muſcles which have branches from the ſame nerve.

8. If none of the foregoing ſigns diſcover the origin of the diſeaſe, it is topical, or protopathic, or idiopathic to the part affected.

9. A diſcovery of the ſource of the diſeaſe directs the place where to apply medicines: In a protopathia they muſt only be applied to the part affected; in an affection by conſent only, to the cauſe of the diſeaſe; and in an idiopathia both to the one place and the other.

I. A palſy or cynic contraction of the under-lip by conſent has its origin either in the clavicle and neck, the origin and courſe of the plalyſma myoides, or at the third vertebra of the neck, where the nerve of this muſcle has its origin, or from the third branch of the fifth pair of nerves, which paſſing through a hole of the under-jaw at the ſide of the chin, gives a branch to this muſcle.

II. If the jaw cannot move downwards, it ariſes either from a compreſſion or debility, or palſy of the depreſſor muſcles of the lower-jaw in their origin or courſe, or from the contraction of the temporal muſcle or maſſeter, or from the affection of the third branch of the fifth pair of nerves, which beſtows branches on theſe muſcles, or of the portio dura, which communicates three times with this branch of the fifth pair.

III. If from a ſtroke or tumor in the breaſt a pain is felt in the os pubis and teſticles, the exterior oblique muſcle of the abdomen is hurt, or ſtretched in its origin on the breaſt, which occaſions the pain at the os pubis, where its tendon is inſerted, and the tendon being ſtretched by preſſing on the ſpermatic veſſels and cremaſter, which paſs through it, cauſes the pain

of

of the testicles: If the pectoral muscle is hurt the arm cannot move inwards: A stroke or tumor on the fifth vertebra of the back, where the nerve which moves the pectoral and exterior oblique muscle of the abdomen has its origin, may create these symptoms in the same places; but the deltoid, serratus minor anticus, aniscalptor and obliquus inferior, which receive branches from the same nerve, would also be affected.

IV. A tumor or stroke on the os sacrum produces sometimes an inability to move the arm down or backward, by hurting or compressing the aniscalptor. This may arise from an affection of the nerve which moves the same muscle; but then the psoas, complexus, splenius, &c. which receive branches from the same nerve, will be affected.

V. If, after a stroke on the fifth vertebra, the neck cannot bend without great pain, the rectus colli is hurt. If the hurt arises from the compression, or stretching of the nerves, the pectoral muscle, serratus minor anticus, aniscalptor, and the obliqui abdominis, which have branches from it, will be affected.

VI. If one cannot bend the arm, it arises from the head of the scapula or from the humerus; if it comes from the origin of the nerves in the neck, the flexors of the thumb and fingers will be affected.

VII. If the thigh cannot bend, the origin of the psoas is affected by some tumor or stroke on the first vertebra, or from a compression of the origin of its nerve in the same vertebra; in this case, the muscles of the abdomen, aniscalptor and sacrolumbalis are affected. The iliacus internus may hinder the same motion. If it arise from its nerve, the gluteus major will be affected. If it moves not inwards, the triceps from the os pubis, or its nerve which communicates with the gracilis, iliacus and two obturatores, is affected. If it extend not the glutei, or the nerve which rises from the first pair of the os sacrum, and communicates with the iliac, the muscles of the abdomen are affected.

VIII. An impediment to croſſing the legs lyes in the coſta of the ilium, where the ſartorius has its origin, or at the third vertebra of the loins, the origin of its nerve, and then the vaſtus externus and crural, having branches from the ſame nerve, will be affected. If the tibia bow not, the fault may lie in the iſchium, where the biceps, ſemimembranoſus and ſeminervoſus are, or from the laſt vertebra of the loins and the os ſacrum, which afford the nerves to thoſe muſcles; the ſartorius and triceps have branches of the ſame nerve with them.

Laſtly, if the tibia extend not, the cauſe may be in the coſta of the ilium, where the rectus and faſcia lata ariſe, or in the trochanter major, minor, or the intermediate ſpace betwixt them, where the vaſtus externus, internus, and cruræus, which extend the tibia, have their origin, or in the vertebræ of the loins and os ſacrum, and then the other muſcles of the thigh and leg, which have nerves in common with thoſe, will be affected.

IX. If the foot cannot be extended, or the heel pulled upwards, the gaſtrocnemii are affected in the ham or in the calf of the leg, or their nerves in their origin in the laſt vertebra of the loins and os ſacrum. In this caſe the flexors of the tibia, the triceps, tibiæus poſticus and the two flexors of the toes which receive branches from the ſame nerve, are affected. If the foot move not inwardly the fault lies in the head of the tibiæus poſticus, or in the laſt vertebra of the loins and os ſacrum, which will be accompanied with the debility of all the muſcles juſt now named, becauſe of their communication of nerves. If the foot cannot bow, it has its origin at the head of the tibiæus anticus, in the external head of the tibia, or in the top or middle of the fibula, where the peronæus anticus riſes, or in the laſt vertebra of the loins and cs ſacrum, where the crural nerve has its riſe. In this caſe alſo all the muſcles laſt named will be affected too.

I omit the other affections of the feet, as I did thoſe of the hands, becauſe their muſcles are not placed at any conſiderable diſtance from their inſertion, and all

all their nerves come from the crural, as the other did from the brachial nerves.

Theſe few inſtances among many others ſhew how dangerous it is to truſt the cure of the diſorders of our body to one who is ignorant of its parts and ſtructure.

An Eſſay on the improvement of medicine, by Dr. JOHN DRUMMOND *ſenior, Preſident of the Royal College of Phyſicians in Edinburgh.* Vol. I. art. 25.

BY accurate obſervations and juſt reaſoning upon them it is that phyſick can be brought to any degree of perfection; one of theſe is by no means ſufficient for the purpoſe; the greateſt maſters of reaſoning have often proved the moſt unſucceſsful interpreters of nature, by neglecting to conſult nature herſelf, and overlooking the moſt obvious phænomena.

On the other hand, many who have employed themſelves in making obſervations of facts were utterly incapable of putting them to the right uſe, or have not taken care to repreſent them in ſuch a way as to be uſeful to others.

It has been the misfortune of this art to be loaded with numbers of names to each diſeaſe, and minute and ſubtile diſtinctions of them, by which a beginner is apt to imagine that each name denotes a diſeaſe very different from any other, and that he muſt learn a particular method of cure adapted to each; whereas if the matter was duly conſidered, it would appear that theſe numerous liſts might be much abridged by reducing many diſtempers to the ſame claſs. It is indeed ſcarce poſſible to find two caſes in any diſeaſe ſtrictly parallel; but it would be ridiculous from every accidental circumſtance in a caſe to diſtinguiſh it with a new name, when the principal ſymptoms are the ſame in innumerable caſes, and ſhew that they have the ſame common cauſe, the ſame general indications,

and therefore ought to be reduced to the ſame claſs. It would be of great uſe to ſtudents of medicine, to accuſtom themſelves to form ſimple and diſtinct ideas of diſeaſes, and in their firſt conſideration of them, to ſet aſide all the ſmaller differences and accidental circumſtances, and to ſearch out that which is of moſt conſequence in any diſeaſe, and wherein it agrees with moſt others. Some examples will illuſtrate what I mean.

Authors diſtinguiſh an hæmoptoe into a great many ſpecies, ſuch as anaſtomoſis, diaireſis, diapedeſis, rixis, and diabroſis, and write a great deal of the different cauſes of theſe hæmoptoes, and of the ſigns by which they are to be diſtinguiſhed, which however are of very little importance; on the contrary, it would be more for the advantage of a beginner, to conſider a hæmoptoe ſimply as a præternatural flux of blood, and as ſuch it agrees with the hæmorrhagia narium, vomitus ſanguineus, diarrhea cruenta, hæmorrhoides, mictus cruentus, profluvium nimium menſium, &c. all which have the ſame immediate cauſes, the ſame effects and conſequences, and ſuggeſt the ſame indications of cure, viz. In the beginning, the quantity of blood muſt be diminiſhed, and a revulſion made by opening a vein in the arm, foot, &c. the velocity and rarefaction of the blood muſt be moderated by cooling medicines: And laſtly the dilatation or rupture of the veſſel muſt be contracted and ſtrengthned by aſtringents. It is true that the ſituation and function of ſome parts from which the blood flows, make the diſeaſe more dangerous, the application of remedies more difficult, and their effects leſs certain in ſome hæmorrhages than in others; yet the ſame method muſt take place in all, and therefore the general ſtile of this claſs of diſeaſes ought to be hæmorrhagia; and it would be as needleſs to treat of each of them as a diſtinct diſeaſe, as it would be to diſtinguiſh the rheumatiſm into as great a variety, becauſe it ſeizes on the neck, arm, hand, leg, foot, &c.

Riverius reckons above thirty different kinds of fevers, and Sydenham has increaſed them to double that number; but certainly phyſicians have obſerved ſome-

ſomething common to all theſe diſeaſes, which made them denominate them fevers. The conſideration therefore of this which conſtitutes a fever (which upon examination will be found very ſimple and obvious) with its true cauſes and genuine effects, will give a more juſt and clear notion of the diſeaſe, and lead to a more rational practice, than all that has been ſaid: And it will appear that the moſt natural and uſeful diviſion of fevers is into continued and interrupted.

Opthalmia, angina, and phrenitis, peripneumonia, pleuritis, hepatitis, nephritis, rheumatiſmus, &c. have all the ſame characteriſtic, and differ in nothing but the part affected.

Carus, cataphora or ſubeta Avicennæ, lethargia, coma vigil, or typhomania Galeni, paraplegia, hemiplegia, &c. are only different ſpecies of the apoplexy in a leſſer degree.

Anaſarca, leucophlegmatia, hydrops aſcites, tympanites, hydrocele, &c. differ ſo exceedingly little that they ſcarce deſerve retaining ſo many pompous names.

Some authors have diſtinguiſhed diſeaſes from their cauſes, though theſe do not alter the ſymptoms or method of cure. Morton reckons among the ſpecies of phthiſis thoſe proceeding from a diarrhœa, dyſentery, gonorrhœa, hæmorrhage, and from forty other diſeaſes; and perhaps there are thouſands of remote cauſes more which can produce a conſumption, without varying the common immediate cauſe of the diſeaſe, or the method of cure, and therefore are needleſs to be enumerated.

Theſe few examples may poſſibly give the hint to ſome abler pen to undertake a thorough reformation of uſeleſs names, to which if they pleaſe to tack receipts of extravagant length (*a*), I am perſuaded they would very effectually promote the art of healing.

But I would earneſtly exhort all phyſicians, to beware of falling into the oppoſite fault, of preſcribing, when they have only learned the general name of the diſeaſe, without having exactly and carefully examined

(*a*) See ſome attempts to this end in the Pharmacopœia Reformata.

all the circumſtances both of the patients and of the diſeaſes; for I am convinced, there is ſo little hopes of obtaining any univerſal medicine to cure all diſeaſes, that there is not any medicine proper for any one diſeaſe, in all ſtages of it, and to all patients. As a proof of this, I ſhall curſorily mention examples of ſome of the moſt common diſeaſes, where a particular form of practice generally prevails, and ſhall chuſe out ſuch as ſerve to illuſtrate the ſeveral neceſſary circumſtances taken notice of in the article of morbid caſes.

Suppoſe two perſons ſeized with an apoplexy, one is a full-bodied vigorous young man after a debauch, the other an old feeble perſon, ſubject to catarrhs. Bleeding plentifully muſt be the principal thing to be depended on for the cure of the firſt, although this method would effectually deſtroy the other, who muſt be treated with every thing which ſtimulates.

A rigid old man and a healthy boy are both ſeized with an inflammation tending to a gangrene in their extremities; evacuations and topical emollient applications are proper for the boy, cordials and topical antiſeptics for the man.

A man and a woman of middle age, healthy and vigorous, are, without any previous remarkable ſymptom, taken with a ſmall hæmoptoe; the man is let blood plentifully, kept cool with a low diet, and has aſtringents given him; the woman being near the time of her menſtrua, is to have this natural evacuation forwarded.

Two perſons of the ſame ſex, and equal age, one brought low by a diſeaſe, the other plethoric, catch an ague at the ſame time; the plethoric perſon requires bleeding, and other evacuations; the other muſt be ſupported by a nouriſhing diet and cardiac medicines.

Two men of equal age and ſtrength, one of whom has lived temperately and ſoberly, the other has every day drunk plentifully of wine, are both ſeized with a fever; the firſt is kept ſucceſsfully with cooling emulſions, the other muſt have an allowance of wine; for uſe them in the reverſe way, the temperate man will

will have his fever unſufferably raiſed, and the other will become quite diſpirited.

A child has complained of pains in his belly, ſhrieks frequently, grinds his teeth in his ſleep, and has formerly paſſed worms in his ſtool; a man has been ſeized ſome hours with a fever; both fall into epileptic fits, which are to be cured in each by removing their cauſes, and therefore require very different treatment.

Two perſons brought low, one with a fever, the other with a palſy of ſhort ſtanding, are taken each with a tertian ague; the firſt is to have the ague ſtopt, the other is to bear it as long as poſſible.

One man has been nigh exhauſted with loſs of blood, another has lived too fully for ſome time; both after exerciſe complain of a great anxiety and difficulty of breathing, with a faintneſs, inability in their limbs, and trembling all over their body; their pulſes do not beat ſtrong, and all the perceptible difference is that the arteries of the latter feel hard and firm like a cord; while the former's pulſe is ſoft and makes no reſiſtance; though the appearance in both is the ſame, yet this laſt circumſtance, and the preceding hiſtory determine the diſeaſes to be oppoſite; the one is from the emptineſs of the veſſels; the other from a plethora; and the method of treating them is directly the reverſe of each other.

No rule is more general than that of bleeding in pleuriſies; but if in the fifth or ſixth day of the diſeaſe the patient coughs up pus, blood letting is hurtful.

The common practice in the beginning of the ſmall-pox or meaſles is to let blood; but if the exanthemata are pale, the pulſe low and ſlow, without any oppreſſion at the breaſt, cardiacs are of ſervice, and venæſection dangerous.

Authors forbid letting of blood in a dropſy; yet ſuppoſe a ſtrong man, after overheating himſelf and drinking great draughts of cold drink, to have his belly ſuddenly diſtended with water; and upon this a great difficulty in breathing follows, and all his veins grow turgid; he muſt be blooded, otherwiſe his diſeaſe will increaſe, and the circulation of the blood in the lungs will at laſt be entirely ſtopt.

To cure the jaundice safely in a plethoric person, especially if attended with an inflammation of the liver, it is necessary to begin with taking blood, contrary to the general rule in this disease.

In the same manner, violent hysteric symptoms occasioned by the over-fulness of the vessels preventing the menses to flow, are only to be removed and the menses to be brought on by blood-letting, notwithstanding the general maxim of making no evacuation of blood at this critical time.

In short there is no disease, nor any medicine so universally useful in it, but I can shew cases where that medicine would be very improper. Therefore the rational physician will lay the foundation of his practice on reason and experience united.

The experiment of cutting the recurrent nerves, carried on farther than has hitherto been done, in a letter from Dr. GEORGE MARTINE *Physician at St. Andrew's to Mr.* MONRO, *P. A.* Vol. II. art. 8.

IN the early times of physick, the doctrine of the brain and nerves was little known; at length physicians begun to dissect with care, animals both living and dead; and then found that by cutting or compressing a nerve, the parts on which it was bestowed became motionless: The truth of this might be proved on any nerve, but the most remarkable instance is the making an animal dumb by tying the nerves near the windpipe; those who first made this experiment, imagined that the animal became comatous, which effect they ascribed to the obstruction of the passage of the vital blood, from the heart, by the arteries, to the brain; but in Ruffus's time this effect was found to arise from the ligatures made on the adjacent nerves; and Galen proved, that tying the arteries occasioned the whole vessels at the side of the trachea to be suddenly swelled, which proceeded from intercepting the influence of the nerves on the larynx, and found that these nerves

came from the par vagum, and paſſing up along each ſide the windpipe, were expended on the part above mentioned: He in the midſt of a publick aſſembly proved the truth of this; which was likewiſe confirmed by the following accident: An ignorant ſurgeon in extirpating a tumor from a boy's neck, cut one of theſe nerves, upon which he loſt half the ſtrength of his voice, but he eſcaped better than another child, who was left quite dumb after the like operation, both the nerves being divided. This experiment of cutting theſe nerves, was alſo confirmed by Veſalius (a).

About twelve years ago, I made the experiment in a pig which anſwered exactly; therefore I cannot agree that the voice would not be entirely loſt, though both the recurrent nerves were divided, whilſt the ſuperior branches ſtill ſupply the larynx; indeed Galen taught an inoſculation of the recurrent, with the ſuperior branches of the 8th pair, which was copied by Maſſa, Euſtachius, and Willis; but I could never find nerves diſtributed to the larynx, but from the recurrents. When the voice is thus loſt, a doubt may ariſe, whether the animal after ſome time may not recover it again. To put this out of all doubt, I made the experiment on a young pig: After cutting the nerve on one ſide, the voice was only weaker; but upon cutting that on the other ſide, the animal became quite dumb; but you might ſee plainly, by the motion of the thorax, that he endeavoured to make a noiſe. He ſucked, and ſeemed well for ſome days, and though he could make a little grunting, he could never ſqueak, but breathed as though the glottis was too wide.

This diſorder increaſed, and by degrees he loſt his ſtrength and appetite, and died in ſeven weeks after. Upon diſſecting the pig, I could not find that the larynx had ſuffered any great change, but the orifices of the ventricles were relaxed, and the membrane of the glottis inflamed on each ſide.

It is plain the ancients well knew, that the voice

(a) Hum. corp. Fab. vii. 19. p. 571.

depended

depended upon a proper aperture of the glottis, for the author of the treatiſe de voce & anhelitu, ſays, ſi inſtrumenta vocis ampliſſima eſſent tunc vox deſtrueretur. So we conceive, that when the recurrent nerves are cut, the glottis will ſtand always open, and be incapacitated from being ſhut at the will of the animal.

Obſervations concerning the placenta, the two cavities of the uterus, and Ruyſch's muſcle in fundo uteri; by Dr. THOMAS SIMSON, *Chandos Profeſſor of Medicine at St. Andrew's, in a letter to Dr. John Pringle Phyſician, and Profeſſor of Ethics in the Univerſity of Edinburgh.* Vol. 4. art. 13.

THE placenta has generally been looked upon as an original part among the ſecundines; but, from obſervations, it ſeems to have no place in the ovarium, nor in the uterus, till once the ovum becomes contiguous to the fundus; at which time, every part contiguous becomes really placenta, which is the whole of the chorion, except that ſmall portion which lies contiguous to the cervix; ſo that at firſt the placenta involves the whole embryo, except ſo much as joins to the paſſage from the fundus to the cervix, where ſometimes one part, and ſometimes another, of the ovum happens to fix; and conſequently ſometimes one part, and ſometimes another, is placenta, which is vaſtly larger than the membranous part at it's firſt appearance. Heiſter (a) has given us the moſt diſtinct account of this affair, and elegantly repreſented a fœtus of three months, included in its integuments. He tells us, that the conception was almoſt quite ſurrounded with ſuch a ſet of vaſcular fibres as he has repreſented, in the lateral and under-margin of his figure, but that he had ſcraped ſo much of them off as to give a view of the fœtus through the membranous part.

(a) See the fourth edition of his anatomy, fig. 27.

This

This conception ſeems to have every thing in its natural ſtate; whereas, theſe early conceptions are generally more diſguiſed, either by lying longer in the uterus, or being more ſqueezed when diſcharged; and thus they are found without the embryo, and having the fibrous excreſcencies obliterated; ſo that Ruyſch took them for clotted blood (a), and to Harvey (b) they appeared like ſo much jelly. This appearance I had an opportunity of obſerving: A lady miſcarried about the third month, with a great effuſion of the lochia; which gave me reaſon to ſuſpect that the after-burden was ſome time looſe in the uterus, before it was diſcharged: The whole conception was about the bigneſs of a gooſe-egg, and uniform through its external ſurface, which had ſomewhat the appearance of a gelatinous ſubſtance: But ſcraping upon this, I found it much of the ſame fibrous thick texture, as the after-burden in the laſt months, till I came as far as the chorion, from whence I ſcraped the fibrous part all round, ſo as to leave it a pure clean membrane, ſuch as what Ruyſch mentions as the only inſtance wherein he did not find the placenta involved with blood; which I think gives juſt ground to ſuſpect, that the fibrous part had been torn off, which might eaſily have happened in that tender ſtate. When I came to the membranous part, I ſaw diſtinctly the fibrous part every way inſerted into it; nor did I, through the whole circumference, find the leaſt difference as to the manner the fibrous part was attached to the membranous, ſo as to ſuſpect one part for placenta more than another. Only at one part I found a ſmall ſlit, which led into the membranous bag into which the ſhoulders of an apoſteme lancet would have had difficulty to have entered. When I opened the bag fully, there was nothing in it of fœtus or humour: Only to one part I found hanging about an inch of the umbilical cord.

This gives a diſtinct notion of Galeatius's caſe; of

(a) Obſerv. Decas 2. obſerv. 10. Theſ. 6. N. 40. (b) De generat. diſſert. 69.

his ſacculus and adhering fleſhy ſubſtance, which he could not diſtinguiſh from the placenta; and ſhows that the embryo had been ſqueezed through the aperture found in the conception. How theſe apertures happen, ſo as to allow the ſmall embryo to paſs them (which we may ſuppoſe to take place frequently, ſince Ruyſch tells us the embryo is frequently miſſing (a);) may eaſily be underſtood on my hypotheſis, that the part of the ſecundines next to the cervix, where they are not contiguous to the fundus, keeps always membranous, and has nothing to ſupport it; ſo that it muſt eaſily yield, and being deſtroyed, the part which is covered muſt appear only as a ſlit. All theſe caſes are mola's with La Motte (b), where the ſmall membranous part is torn, and the water and embryo diſcharged, which happens frequently; and this probably has given ground to the numbers of mola's which we have recorded, and occaſion of their being diſtinctly treated of by almoſt every writer in midwifery, who have given us ſtrange accounts of them. As moſt obſervators concur as to the placenta ſurrounding the embryo for the firſt two or three months, ſo it is generally agreed upon, that it is ſtill leſſer in proportion to the membranous parts of the integuments, the nearer they come to the ninth month. Blaſius obſerved, that the placenta covered almoſt the whole embryo in the fourth month. This placenta had much the appearance of that deſcribed by Heiſter, and its proportion to the membranous parts is agreeable to Ruyſch's repreſentations. I lately ſaw a miſcarriage of twins, the firſt of which came away without its integuments, and the other with them, all entire, in the midſt of the waters, alive, though but of five months. In both, the placenta was much of the ſame extent with the membranous part, and not inferior to what it is at full growth: So that for the four laſt months the placenta is obſcure, but that of the membranous part conſiderable, being at leaſt five times larger than the placenta at that time.

(a) Theſ. vi. num. 81. (b) Des accouchemens liv. 1. obſ. 3.

From the histories already quoted it appears, that the whole surface of the ovum, which is at first contiguous to the cavity of the fundus, is in fact placenta; for further confirmation of which doctrine, I shall consider the rise of the placenta in other animals.

In animals, where the ovum has its supplies by means of cotyledons, which are original parts in the uterus or its horns (a), it is evident, that such parts of the chorion or surface of the ovum become caruncle or placenta, as come in contact with the cotyledons, and these only: In the hind, in whose uterus Harvey takes notice of ten cotyledons, there are exactly so many caruncles upon the chorion, and of the same extent and figure: In sheep and cows, round whose chorion Needham has found sixty, seventy, eighty cotyledons, the caruncles always correspond in number and shape; a clear proof that the caruncle is produced upon the chorion by the influence of the cotyledon. In mares and swine, all the time the ovum keeps disengaged from the uterus, nothing fibrous or like a caruncle appears upon the chorion; nor do the cotyledons appear, but upon the conception coming in contact with the uterus, the cotyledons are seen, and caruncles answering to them (b). The same thing holds in those animals who have particular cells along the horns for receiving and nourishing the ovum; such as rats and mice, in which the ovum is joined to the cell by mediation of one cotyledon; upon their invelopments there is but one caruncle exactly shaped like the cotyledon: But in dogs and cats, and such like, where there is a particular cell fitted for the ovum, without the mediation of a cotyledon, the placenta is exactly of the shape of the cell, which is a portion of a cylindrical tube; and the cell being open at both sides, the membranous part extends itself to them: So that in these creatures the placenta appears as a belt round the chorion. And as in the separation of the human placenta, blood always appears, so it does

(a) Ad finem Thes. 5. Arcul. 3. Ruysch. (b) Needham Embriotomia.

in them upon the ſame occaſion, but not in animals with cotyledons, except the cotyledons be brought away with the caruncles as I have ſeen frequently in cows: So that the cells, in which the ovum fixes without cotyledons, are prepared for the engraftment of the ovum, in the ſame manner as is the fundus of the human uterus; ſince, as in them, all becomes placenta, contiguous to the cells, and that part membranous which extends beyond them. And thus in all animals, it is manifeſt, that the fibrous part of the ſecundines or placenta is owing to the ſoil; there is a proper ſoil for ſuch a production in every animal, though prepared in a different way. There are other material conſiderations, which add to the force of our arguments. By this doctrine of ours, it follows, that when two or more ova arrive at once at the cavity or fundus uteri, all their placenta's will be confined to it, and conſequently will only take up the ſpace ordinarily poſſeſſed by one; and all of them being contiguous and taken together, will be of the ſhape of the ſingle placenta. This is a neceſſary conſequence of what we have advanced, and I refer to practitioners, if in births where there are more than one at a time, they do not find either all the placenta's together, or marks of their having been contiguous. In the caſe of twins before-mentioned, I obſerved the place where the two had been contiguous, and evidently ſaw marks of their being torn away from one another by violence. In others, which I conſidered this in, when the infants had come to their full time, though I ſaw not ſo much marks of violence, yet I eaſily diſcerned the ſides of the placenta's which had been contiguous: But inſtances where they come away ſeparate are not ſo frequent as thoſe where they come away united: And this holds where there are three or four children at a birth, of which we want not examples. Thus la Motte (a) has two inſtances of three at a birth; in one of which, the placenta's were all joined together as one; in the ſecond, two were joined, and the third

(a) Ibid. chap. 42.

came away by itself. Mr. Saviard (a) gives us two examples exactly parallel. Vieussens, in his treatise upon the uterus, tells us, that he saw an instance where the three were in one, though their boundaries were most distinct. Luca Shræckius gives an account (b) of four produced at a birth, all of whose placenta's were combined as one, though separated by certain furrows into four parts, each of which had an umbilical cord, which is always the case where different placenta's are thus combined. The whole circumstances argue for what I advanced, that every part of the ova which lies next the fundus uteri, becomes placenta; and if at once there are received two, three or four ova, then so much of every one as touches the fundus becomes placenta; and of necessity all the placenta's must be contiguous, they filling up the cavity of the fundus exactly amongst them. And as by the light I have set the placenta in, we see how the placenta's are always crowded together, when there are more than one at a birth; so from it we come to understand how, in cases where there is but one, as well as where there are more, the place of the placenta into which the umbilical cord is inserted, should be altogether uncertain; for the ovum with the embryo attached to it, landing at the fundus, that part of it into which the umbilical cord is inserted, will answer sometimes to one part of the fundus, and sometimes to another, there being nothing to determine the loose egg into one posture there more than another. If we suppose then the part of the ovum into which the cord is inserted, fixed at the most vertical part of the fundus, and that all of it becomes placenta contiguous to the fundus, then it is plain, the cord will be found at the center of the placenta. But if we suppose that the part of the ovum with the cord fixes near to the boundary of the fundus and cervix, then the cord must be at the circumference,

(a) Nouveau recueil d'observations, num. 82. (b) Miscell. N. curios. dec. 1. an. 2. obs. 9. p. 26.

as I have seen it several times, and in one case of twins, where the placenta's were both united, both cords were inserted within half an inch of the circumference of their placenta's. I have seen it in a variety of places of the area different from the center; in which cases the insertion of the cord had got a different place of the fundus to settle in form the other two. So that all these phænomena become most plain and intelligible upon admitting our hypothesis, and are most certain proofs of its authenticity. There is one thing follows from this doctrine, which perhaps will be somewhat debated, which is, that extra-uterine conceptions can have no placenta. Authors give no instances to the contrary: They indeed speak, as if they had no doubt but they should have had them. But this seems to have arisen wholly from prejudice; for upon examining into the distinct cases, we have no ground to reckon that they had. What I have yet met with on this head, rather confirms my doctrine than opposes it, that the fundus uteri is a place peculiarly fitted for the growth of the placenta, as well fitted soils encourage the growth of the roots of trees and shrubs, many of which are propagated by the branches, however placed; so that every part of them seems equally fitted to be root or branch. Against this doctrine, of every part of the chorion becoming placenta which is contiguous to the fundus, it may be urged that sometimes in the middle of the placenta there have been found membranous portions. But such examples as these rather add than detract from the force of my arguments; since by them it would appear, that what is placenta was originally membranous.

I must next consider whence the cavity is formed, which in the last months contains the infant, the greatest share of the waters, and all the secundines, except the placenta: For since the placenta possesses all the fundus, the rest of the cavity, which contains the other parts, must arise and have its formation from some other part; the uterus has, contiguous to the fundus, another cavity, the cervix; contiguous to

2 which

which we obſerved the ovum membranous. So that ſince the fundus does not diſtend beyond the placenta, the reſt of the cavity at the laſt months muſt ariſe from the cervix; and agreeable to this the os tincæ then opens into one uniform cavity, where cervix and fundus are confounded together. And thus Deventer's figure of the uterus immediately after child-bed is of a globular ſhape, comprehending both fundus and cervix; and from what Veſalius, Ruyſch and Deventer obſerve, concerning the poſition of the round ligaments and tubes of the uterus (a), in the firſt and laſt months, it is manifeſt that the uterus does not diſtend equally in all its parts: For not only theſe appendices of the uterus keep very near to the os tincæ, ſo that the greateſt part of the bulk of the uterus is above them towards the laſt months, but thoſe upon the one ſide are much lower than their neighbours upon the other. So that we muſt ſuppoſe the uterus to extend ſometimes to one ſide more than to another. And from this it muſt follow, that ſometimes the placenta will be found in one place of the cavity, and ſometimes in another; and not as Ruyſch and Deventer maintain, always fixed at the vertical part. In an uterus I ſaw with Dr. Douglas, where the ſecundines were ſtill in ſitu, the placenta was wholly to a ſide; a certain proof againſt their authority. But however inconſtant the uterus be, as to the manner of its diſtenſion, this is certain, that the placenta inviolably adheres to the cavity of the fundus; with this it is ingrafted, and can never ſhift its place. And therefore as we allow that the placenta is found ſometimes in the lateral parts of the uterus, ſo it is a ſign that the uterus has diſtended much more on one ſide than another: And this ſeems pretty much confirmed by the obſervation of ſuch as have been frequently pregnant, ſome of which have been ſenſible, that the bulk of the uterus, in one courſe of pregnancy, has had a

(a) Veſal. lib. 5. cap. 15. Ruyſch. Theſ. 8. n. 3. not. 2. Deventr. Ars obſtetr. cap. 9. fig. 4.

very different ſituation from what it has had in another.

Ruyſch, in examining into the ſtructure of the part into which the placenta was fixed, found, that the fibres were concentrical, runningin ſomething of a circular courſe, and placed at the fundus uteri. But he ſeems to take the fundus in a different ſenſe from what we have done; he meaning by it the uppermoſt and moſt vertical part of the capacity of the uterus, when in its enlarged ſtate; whereas we ſtrictly underſtand by it the cavity which Morgagni deſcribed under that name, in his third figure of the firſt of his adverſaria. And by what we have advanced we reckoned it demonſtrated, that this fundus in its whole extent, makes up what Ruyſch called his muſculus uterinus, this being the part to which the placenta infallibly adheres in all caſes: So that what Ruyſch obſerved of the circular courſe and centrical poſition of theſe fibres, in the enlarged ſtate of the uterus, muſt inſtruct us in the make and ſtructure of that cavity; that it has its fibres diſpoſed in a circular courſe, having the moſt vertical part for their common center, being in miniature, that very courſe of fibres Ruyſch has deſcribed as one muſcle, and repreſented as ſuch in his tractatio anatomica de muſculo in fundo uteri; where though he has repreſented none of the fibres as a compleat circle, yet they are all circular, keeping the courſe we have defined: In that tract he ſpeaks, as if part of the placenta did not anſwer to the muſcle in ſome caſes, but tells us no inſtance where he found it ſo. From our account of things, the placenta can never be found ſeparate from this muſcle, which originally was the whole of the cavity of the fundus uteri, to which the ovum inevitably fixes. In the enlarged ſtate of the uterus, the fundus anſwers well the office of a muſcle, in ſeparating the placenta: For the placenta of itſelf contracts not, and therefore on the contents of the uterus being diſcharged, and ſo the overſtretched fibres left at liberty, theſe circular ones, attached to the placenta, in contracting, muſt deſert the placenta

placenta and leave it loofe, which is the office Ruyfch allotted to it. And as he has defcribed this part very concave and hollow, I make no doubt that thofe who fee the uterus immediately after delivery, will fee this cavity forming by itfelf, as it has appeared to Ruyfch. What confirms me in this notion is, that on managing an adhering placenta, I have found it included in a diftinct pouch by itfelf; which particularly happened in a cafe where there were twins, and where the fecond child was fo included in this diftinct cavity, that after the delivery of the firft, when I was fearching for the placenta, not fufpecting twins, I felt no more of the fecond than part of the head, though now I was in the region of the fpleen; and before this place there was a large vacancy between it and the os tincæ: After I had made way for the child, I had occafion to bring both placenta's, though they were diftinct, from the fame cavity, which was contracting very faft. If I had not had a particular notion of the fundus at that time, I fhould have been ready to have fufpected an uterus divided in two, or an uterus with horns. Since that time, I was called to a woman who continued in very hard labour, though delivered of her child, and whofe belly, immediately above the os pubis, was bulky and hard: I got eafy accefs into the uterus, which was hard and inflamed all round its cavity, and part of it forced down below the os pubis into the vagina; which certainly was the occafion of the labour: But fomewhat to the right fide above the pubis, I was fenfible of a diftinct cavity, which two or three fingers had difficulty to enter. This I reckoned the fundus taking its proper form by means of its circular fibres; which, according to what we have fhewed from Ruyfch, are to be diftinguifhed from the other parts of the uterus in its enlarged ftate. From all which hiftory, the defign of parting the uterus into an upper and under cavity is manifeft, the firft being defigned for the convenient ingraftment of the placenta into one certain place of the uterus, and the other for receiving and giving place to the membranous part of the fecundines:

dines: By which contrivance, the musculus Ruyschii and placenta must always be together, and the membranous part of the secundines must always be contiguous to the os tincæ.

I shall conclude with one supposition relating to the globulous small bodies scattered through the whole bounds of the cervix; and that is that they secrete a mucous humour to keep separate the membranous part of the secundines and the contiguous cervix. It was most convenient that they should be kept from uniting; and nature, for this end, in other places, has contrived such a set of small glandular bodies; so that it is natural to suppose they may be employed the same way here: For, in pregnancy, the inner surface of the cervix is so dilated, as to be of equal extent with the membranous part of the secundines, and of consequence, the glandular bodies will be proportionally scattered through that space; and, in their most enlarged state, come to supply that great quantity of mucous humours which flow from women near the time of the birth: Which must certainly flow from the whole bounds between the membranous part of the secundines and contiguous part of the uterus, and so lubricate much the os tincæ, as Sanctorinus would have them, whose account of this part, both as to the largeness of the cervix toward the birth, and the disposal of these glandular bodies, agrees with our hypothesis (a)

(a) Observ. Anat. cap. 11. §. 9.

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An Eſſay towards diſcovering a ſafe remedy for diſſolving the ſtone ; by ROBERT WHYTT, *M. D. Fellow of the College of Phyſicians at Edinburgh.* Vol. v. art. 69.

THE difficulty attending a courſe of Mrs. Stephens's medicines is ſo great, that ſeveral, after taking them for many months without any benefit, have ſubmitted to be cut, rather than go on any longer with a medicine ſo extremely nauſeous, and which had greatly increaſed their pains, without bringing any thing away (a).

Dr. Hartley (b) has endeavoured to remedy this by leaving out the ſuperfluous part of her compoſitions, yet the egg-ſhell-powder is ſo nauſeous, and the quantity of ſoap ſo great, that few will continue to take the medicines even thus reduced for any conſiderable time.

It appears from Dr. Hartley's (c) account, that the powder which Mrs. Stephens uſed long before ſhe gave ſoap in any quantity, is no other than lime ; and from the experiments of Mr. Hales, that quicklime is the only thing which gives virtue to her compoſitions. Hence it was probable that lime-water would prove a good diſſolvent for the ſtone ; and it is reaſonable to expect great benefit from it ; for by its means the virtues of a greater quantity of lime may be ſafely conveyed into the blood. In ſoap the lime bears an inconſiderable proportion to the other ingredients, (d) and

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(a) Dr. Jurin's caſe, p. 4 and 5. (b) See his ſupplement to the view of the preſent evidence. (c) Hartley's ſupplement the preſent view p. 1.

(d) In England they make ſoap with a lye of potaſh and quicklime, boiled up with fat and oil to a proper conſiſtence, and it is upon the ſuppoſition of Alicant ſoap being alſo made in this manner that Mr. Hales's experiments moſtly proceed ; for having found a lye of potaſh and quicklime to diſſolve the ſtone more quickly than any thing except ſpirit of nitre, it was reaſonable

of the powder greatly weakened by being expoſed ſixty days to the air, only a few ſcruples are exhibited a day, and it is probable that even this, for want of being ſufficiently diluted, has been the occaſion of great heat and uneaſineſs in many people's ſtomachs. It has been found by experiment that lime-water will diſſolve a ſtone, and therefore it is ſomewhat probable that it would ſo far medicate the urine as to enable it to diſſolve one in the bladder. But hypothetical reaſoning on the virtue of drugs is unſatisfactory; the effects of lime-water therefore will beſt appear from the following hiſtory:

Mr. David Millar of Kirkaldy, about 60 years of age, had been often diſtreſſed by ſtones paſſing from the kidneys to the bladder ſince the year 1704; ſometimes he has had ſevere fits of pain once or twice in a year, and ſometimes but once in two or three years, and theſe from two to fourteen days continuance, but in a few days after theſe fits, he voided ſtones, till June 1740, when after a painful fit, the ſtone arrived at his bladder; but all his endeavours to make it paſs, as riding, walking quick, jumping and drinking plenty of proper liquors were in vain. For half a year after this he was troubled with frequent obſtructions in making urine, although without any great pain, except in voiding the laſt drops. Since March laſt (1741) upon riding or walking a mile or two, his urine was mixed with blood. From January he could not retain his urine, which went from him every eight or

able to expect that ſoap, of which this conſtitutes ſo conſiderable a part, ſhould be poſſeſſed of a diſſolving virtue likewiſe! But I have been informed by a gentleman of undoubted credit, who was at Alicant in Valencia, where the beſt ſoap is made, that there is no quicklime uſed in its compoſition, but inſtead of it only lime-water, which, together with the alcaline ſalt, got from the aſhes of the herb kali, and oil of olives, is boiled in large caldrons, till it acquires a proper thickneſs, when they pour it out on a floor, and before it hardens, cut it into bricks. See alſo Lemery's dictionaire de drogues p. 485. "Savon eſt une compoſition faite avec "l'huile d'olives la plus groſſiere, de l'amidon, de l'eau de chaux, "& de la leſſive tirée de cendres du kali." The ſtarch, he ſays afterwards, is only ſometimes added, in order to make the ſoap whiter and turn ſooner thick.

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ten minutes with ſtimulating pains; yet ſometimes he had, after keeping warm and ſweating, intervals of eaſe for a day or two. In May 1741 he began to take half an ounce of ſoap every day; in the end of July he increaſed it to an ounce, and in the beginning of September to near an ounce and a half; but his pain, bloody urine, and inability to retain his urine ſtill continued. In the end of September, I adviſed him to drink with his ſoap a pound of lime-water, and to increaſe it gradually to three pounds a day, and to drink no more of other liquors than was neceſſary to quench his thirſt. In five days he began in ſome meaſure to retain his urine, and his pain and bloody urine after exerciſe decreaſed. November 13th, he walked ſix miles, yet retained his urine for ten hours together, and then voided it without pain or blood.

November 15th at night, trying to make water, he found a ſtone entering the urethra, and obſtructing it, which it continued to do all night; he ſlept little, and often attempted to urine, but could not, unleſs a very little, and that drop after drop. Next morning, finding an inclination to urine, and endeavouring it with all his force, he voided a ſmooth ſtone about the bulk of a common bean, of a whitiſh waſhed colour; whereas all thoſe he had paſſed formerly were of a brown colour and rough; it appeared plainly to be a part of a larger ſtone.

November 17th, he walked upwards of two miles without any pain or bloody urine.

November 18th, after making urine, he felt ſomething at the neck of his bladder, occaſioning a ſlight obtuſe pain, which he took to be another ſtone.

From this till the beginning of December, he was very eaſy, not having been obliged above three or four times a day to make water, which was never mixed with blood, nor attended with pains; only twice or thrice he found his urine ſuddenly ſtop, when he was voiding it, and once he thought a ſtone was entering the paſſage, which a little after fell back into the bladder; when he ſtumbled or ſtept down a

ſtair,

ſtair, he felt ſomething heavy in the under part of the bladder; his urine during all this time had a great deal of white ſediment, and ſome browniſh flakes in it.

December 3d, at night, the ſtone entered the beginning of the urethra, where it ſtuck, till the ſeventh in the morning, during which time his urine was much obſtructed, coming away in drops, or in a ſmall ſtream with a good deal of pain. From this to the end of December, he was often in the ſame condition, the ſtone ſticking in the paſſage, ſometimes half a day, and ſometimes a day and night, and then falling back into the bladder, but without thoſe piercing pains he felt before the uſe of the lime-water; he could now retain his urine half a day, and then void it without pain. On emptying his bladder he perceived the preſſure of the ſtone, if he walked a little; but when there was any quantity of urine in it, this became leſs perceptible. He now enjoys a good degree of health, and continues uſing the ſoap and lime-water daily, which laſt he frequently takes at his meals, inſtead of any other drink, and thinks his urine taſtes a little of it.

January 4th, 1742, at night, he found a ſtone had got into the beginning of the urethra, which in a good meaſure hindred him from voiding any urine; however, next morning, it came away; it is larger than that which he paſſed before, and is evidently a piece of the ſame ſtone.

For ſome days after the urethra was tender and a little pained, which occaſioned his making urine more frequently than uſual; but this ſoon went off, and ever ſince he has been perfectly free from all pains and ſymptoms of the gravel, which he chiefly aſcribes to the lime-water.

Upon this hiſtory it is natural to obſerve,

1. That the ſtone firſt paſſed was a fragment of a larger ſtone, from its edges being ſharp, while the reſt is ſmooth and round, and a red nucleus plainly appeared in the middle; but it is put out of all doubt, by the ſtone laſt paſt, which tallies pretty exactly with the former, is evidently of the ſame texture, and the

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two together, excepting a ſmall deficiency at one end, ſeem to make up a complete ſtone. Whether what is wanting has paſſed in fragments unobſerved, or quite diſſolved in a white ſediment is not ſo certain. Beſides, as he had no ſtones paſſing from his kidneys to his bladder ſince June 1740, if we deny theſe ſtones to have been one, we muſt ſuppoſe them lodged eighteen months in the bladder, without ever acquiring a greater bulk, or ever endeavouring to paſs, neither of which is at all likely.

2. The ſurfaces of the ſtones ſhew them to have been in a diſſolving ſtate. There are fibres in ſome places plainly broken off, and as the lime-water and ſoap had longer time to act upon this than on the firſt fragment, ſo there appear more evident ſigns of diſſolution about it. In moſt places it looks rotten, and in ſome is eaten ſo deep that ſeveral of its layers are ſeen. Its whitiſh colour is a further proof, as Dr. Hales has obſerved, and as will more fully appear in the following experiments.

3. It does not appear that the ſoap alone had any great influence in this caſe, which might be owing to his not taking it in ſo large quantities as ſome others have done (a).

4. Lime-water appears to have an uncommon efficacy in eaſing the ſymptoms, and probably diſſolving the ſtone in the bladder; for after Mr. Millar had drank it five days, he retained his urine better than he had done for nine months before; the pain in making it abated, and the quantity of blood diminiſhed, and ſoon entirely diſappeared. It is probable, that lime-water has a greater influence in diſſolving the ſtone than ſoap, ſince it poſſeſſes a greater diſſolving virtue out of the bladder. Compare exper. 11. with exper. 70.

That the lime-water ſhould have a more ſudden effect in curing the incontinency of urine than the pain and blood which upon motion generally accompany

(a) The mean quantity ordered by Mrs. Stephens is two ounces and an half.

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it, is eaſily accounted for, ſince as the two laſt proceeded chiefly from the rough ſides of the ſtone wounding the bladder, this muſt in part have continued to happen till the points were worn off. Accordingly the firſt ſtone was pretty ſmooth.

5. Mrs. Stephens's medicines almoſt always occaſion great heat of urine for ſome weeks, or even months, after firſt taking them, yet the ſoap in the way Mr. Millar took it gave him no ſuch uneaſineſs, which is probably owing to his taking it in ſmall quantities and gradually increaſing the doſe, as well as never taking ſo much of it as is ordered by Mrs. Stephens.

The lime-water had ſo very contrary effect, that in a few days it relieved ſome of his complaints and abated others, and with the ſoap was ſo far from injuring his health, that he was eaſier and freer of a lowneſs of ſpirits which he had before laboured under. For four months paſt he has been quite free of all his former complaints, ſo there is no reaſon to doubt of the ſtone being entirely brought away; for if any conſiderable part of it remained, why ſhould he not ſometimes after making urine feel it in his bladder, as he almoſt always did after paſſing the laſt ſtone? By this ſucceſs of the lime-water I was induced to make the following experiments, with a view to a farther diſcoveryof its nature and virtues.

SECTION I.

1. Malt ſpirits poured on a piece of burnt limeſtone, are plentifully abſorbed, without any ſenſible ebullition (only ſome air-bubbles riſe from its ſurface); it does not ſlake till after lying many hours in them. A piece of quicklime immerſed in rectified ſpirit of wine in a cloſe bottle, ſcarce ſhewed any appearance of ſlaking after eight days.

2. Vinegar is more plentifully abſorbed by quicklime than ſpirits, with many air-bubbles, and hiſſing noiſe at firſt, which ſoon ceaſes, and if freſh from the fire will ſcarcely ſlake unleſs continued many hours in it.

Water

Water poured on quicklime which has laid ſome time in ſpirits or vinegar, produces no ebullition, only a few air-bubbles at firſt, the ſtone which has been in the vinegar is longeſt in ſlaking.

3. On putting a piece of quicklime in claret wine, a conſiderable ebullition happens; but in twenty-four hours the ſtone is ſcarce diſſolved.

4. Oil is plentifully imbibed by quicklime, without any ebullition or heat; if put afterwards in boiling water, bubbles of oil riſe from the ſtone, and after ſeveral hours ſtanding, it begins to melt down into a ſoft, fat argillaceous ſubſtance.

Hence it ſeems that oil by ſheathing the fiery particles in the lime, hinders their ebullition with water, as on the other hand it is ſo far changed as to become miſcible with water.

5. A piece of quicklime being put in briſk ſtrong ale, many air-bubbles ariſe, but ſoon diſappear: After twenty-four hours one third of the ſtone was not ſlaked.

Small beer has much the ſame effect, only the ebullition is greater and laſts longer.

Water poured on quicklime, which has laid ſome time in ale or beer produces no ebullition nor eaſily diſſolves it.

6. The heat or cold produced by the mixture of the liquors, with powdered quicklime, are as follows.

Quicklime mixed with lamp ſpirits, ſunk the thermometer from 54 to 53 degrees. With vinegar it roſe in five minutes from 52 to 68 degrees, and then began to fall. With claret it roſe in ſix minutes from 51 to 56 degrees. With ſtrong ale it roſe in ten minutes from 48 to 57 degrees. With cold water it roſe in twenty-two minutes from 48 to 112 degrees, and then began to fall (a).

(a) The quantity of quicklime uſed in this experiment was very ſmall, otherwiſe the thermometer ſhould have riſen much higher, ſince quicklime frequently makes cold water boil.

The lime-water made uſe of in the following experiment was compoſed of one part of freſh burnt limeſtone, and ten of hot water; as ſoon as the lime was precipitated the clear liquor was filtred for uſe. The proportion of eight to one ordered in the Edinburgh diſpenſatory ſeems too ſmall, and affords little water, if the limeſtone be well burnt and freſh, nor is there any difference in the ſtrength of the lime-water made with theſe different proportions. Cold water poured upon quicklime and afterwards filtred has the ſame virtues as the above.

SECTION II.

Experiments with lime-water upon urine.

As the calculous concretions of the kidney and bladder owe their growth to a conſtant appoſition of particles derived from the urine, I thought it might be worth while, previous to any experiments on the calculus, to try the effects of lime-water upon urine and its ſediment.

8. If an ounce and an half of lime-water be added to an ounce of freſh made urine, it immediately loſes its yellow colour, and becomes whitiſh and turbid, and in a little time a white ſediment falls to the bottom, leaving the liquor above pellucid, of a light lemon colour (a), without any ſcum or cruſt on the ſides of the glaſs. N. B. Lime-water does not raiſe any fiery ſmell when mixed with urine, nor does the mixture efferveſce with acids (b).

9. Freſh urine ſtanding by itſelf in a glaſs about forty-eight hours, depoſited a reddiſh brown ſediment upon the bottom of the glaſs with a cruſt of the ſame nature on its ſides; the clear urine being decanted off from the ſediment and cruſt, the glaſs was filled up with lime-water, on which the ſediment roſe from the bottom, loſt it's colour, and the mixture became white

(a) This, as well as the white ſediment, varies according to the ſtrength of the urine.

(b) See No. 60 below.

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and turbid; the cruſt on the ſides of the glaſs diſappeared, and a large light white ſediment fell to the bottom, which, though allowed to ſtand thirty hours, did not in the leaſt adhere to, or leave any cruſt on the bottom or ſides of the glaſs. Having poured off what was clear, I added ſome white-wine vinegar to this ſediment; upon which it immediately diſappeared, and the liquor became clear, which however after ſome hours let fall a dark coloured ſediment.

(α) Hence we ſee that lime-water has not only a power of hindering the urine from reſolving into the principles, which are imagined to give riſe to the ſtone, but alſo of deſtroying and changing their nature after they are ſeparated from it; from which ariſes a ſtrong probability that it ſhould not only hinder the generation of the ſtone in the human body, but diſſolve it after it is formed: Nay, although it ſhould be allowed, that lime-water may in a great degree loſe its diſſolving power before it arrives at the bladder, yet if it ſhall, by deſtroying the petrifying quality in the urine, hinder any new accretions to the calculus, this muſt neceſſarily in time have its ſurface waſhed down and worn away, by the urine continually running along it, and the coats of the bladder acting upon it.

(β) Do not theſe experiments afford us a clear reaſon why the ſtones which Mr. Millar paſſed after drinking the lime-water, were of a whitiſh colour, whereas, all he had voided for thirty years before were browniſh? And does it not ſeem probable, that the great quantity of white ſediment in the urine of ſuch people as have taken Mrs. Stephens's medicines, has been owing to the lime in them? For lime-water produces that ſediment in urine out of the bladder, and by drinking lime-water, Mr. Millar's urine depoſited it in great abundance; the quantity of this however will be increaſed by what is daily waſhed off the ſurface of the ſtone by the efficacy of the medicines.

Does it not likewiſe appear plain from theſe experiments, why Dr. Jurin's urine (eſpecially after his largeſt

largeſt doſe of ſoap lees) was whitiſh and turbid when firſt made, and afterwards depoſited a calcarious ſediment, but which, notwithſtanding the opinion which has hitherto prevailed of its being furniſhed in a good meaſure by the medicines, ſeems only to be owing to the change made by the lime upon the ſediment of the urine; and that lime-water not only changes the colour of the urine, but of the ſurface of the calculus itſelf, plainly appeared in a ſtone (taken from the body of John Greig, who in December laſt died, in the royal infirmary, of an iliac paſſion) which had its external ſurface almoſt intirely white and a little rotten, while within it was of a ſandy colour. Of this no reaſon could be aſſigned but his having drunk lime-water for eight days, to the quantity of about a pint a day; and it is obſervable, that as he left off the lime-water eight or ten days before his death, ſo in ſome places there was a browniſh cruſt beginning to grow over the white ſurface.

SECTION III.

In the following experiments I made uſe of two calculi. The firſt, which I ſhall denote by A, was of a cloſe texture and very hard, and of a grey ſandy colour. The ſecond B was taken out of John Greig's bladder; it ſeemed fully as hard as the former, and was capable of receiving a poliſh; it weighed an ounce and an half, and its ſpecific gravity was to that of water as 1704 to 1000; its colour was the ſame with the former.

10. A fragment of A, weighing 23 grains, being put in lime-water, and kept in a moderate heat, was moſtly rotten and diſſolved in thirty days.

11. A fragment of B weighing 10 grains, after two days nine hours, warm digeſtion in lime-water, had two grains of its ſubſtance rotten and diſſolved.

12. Some lime-water made by ſlaking quicklime with boiling lime-water, diſſolved a piece of A of five grains in ſeven days.

13. A

13. A fragment of A, ſix grains, after ſeven days cold digeſtion in lime-water in February laſt, had loſt none of its weight, nor was its ſurface ſenſibly ſoftened, though it had ſomewhat of a rotten appearance while a piece of B of twelve grains in ſix days cold maceration in the end of May, had two grains and an half of its weight diſſolved.

From this experiment together with No. 20 and 57 below, one may be able to account for Dr. Lobb's having found lime-water to have no power of diſſolving the ſtone (a); for if the limeſtone uſed in making the water was not freſh from the fire (b), and if the experiment was made in an open veſſel, and in the winter ſeaſon, it is no great wonder if even, after a cold maceration of twelve weeks, there was no appearance of diſſolution.

14. A piece of A weighing nine grains was diſſolved by lying ſeventeen days in lime-water made with calcined egg-ſhells in a digeſting warmth.

15. A fragment of A of ſix grains was, by two days warm digeſtion in lime-water made with oiſter ſhells, reduced to two grains, and in three days to leſs than one grain.

16. A piece of B, eight grains, in thirty-ſix hours digeſtion in oiſter lime-water, loſt about three grains and one fourth.

17. A piece of B, eight grains, in thirty-ſix hours warm digeſtion in lime-water made of cockle ſhells, loſt near three grains and an half.

The lime-water, eſpecially that from ſhells, generally diſſolves the ſtone by making it throw off white rotten ſcales, if allowed to lie long enough in the water, and if the glaſs be ſhaken now and then, are reduced to a white mucus reſembling the white ſediment of No. 9. and when dried, a fine lime. On adding vinegar to this white mucus, it loſes in a day or

(a) Treatiſe of diſſolvents of the ſtone, p. 326.

(b) That this was the caſe is highly probable, ſince he made his water with unſlaked lime, which he in the next paragraph tells us was lime a little ſlaked.

two its white colour, and acquires much ſuch a one as the calculus of which it was a part has, when reduced to powder; which further ſhews, that the white ſediment in the urine, as well as the white mucus here, is not derived from the lime, but wholly from the parts of the ſtone, and groſſer parts of the urine, thus changed by the lime-water (a).

18. A piece of A, ſix grains, was rendered ſoft and entirely rotten, by a cold maceration of ſeventeen days in oiſter lime-water, in February laſt.; but in the middle of May having infuſed cold a fragment of B, eleven grains, in ſome of the ſame lime-water, it loſt in three days near five grains, and in eight days was reduced to a nucleus weighing three grains.

From theſe experiments it appears, that oiſter and cockle-ſhell lime-water poſſeſs a greater power of diſſolving the calculus than that of ſtone-lime, which is inferior to it likewiſe with regard to its purity, and as it may participate of ſomething mineral or metallic, is not ſo ſafe.

19. To make lime-water with oiſter or cockle-ſhells, the proportion I would recommend is ſeven, or at moſt eight pound of water to one of calcined ſhells (b); nor is there any danger in the ſtrength of lime-water made in this manner; for a man has drunk four pints, and a boy of eight years of age two, every day without any inconvenience.

The ſhells will calcine in any fire, provided it be hot enough, and the cockle and oiſter with much leſs trouble than the egg-ſhells; if they are friable and white they are ſufficiently burnt; but if grey, they muſt be put to the fire again.

If cold water be poured on ſhell lime, little heat or ebullition enſues; yet the water got off it ſeems to have as great a power of diſſolving the ſtone as when it is made with boiling water, but is more harſh and diſagreeable. The water ſhould be allowed to ſtand four

(a) See No. 9. above.

(b) An earthen veſſel is preferable for this purpoſe to a wooden or copper one, as the firſt will probably give it a bad taſte, and the ſecond poſſibly a worſe quality.

hours

hours upon the ſhells, or longer if a great quantity is made at once.

20. A fragment of B, ſeven grains infuſed in lime-water made of oiſter-ſhells, which had laid thirty-five days in the open air after calcining, had, in four days in a moderate heat, about three grains of its ſubſtance diſſolved; whereas a piece of B, eight grains, by digeſting three days and twelve hours in lime-water made with ſhells freſh from the fire, loſt about ſix grains; nay, I have obſerved that after the ſhells have been but fifteen hours from the fire, they neither make ſuch an ebullition with water, nor have ſo much diſſolving power as when juſt taken warm from it.

I have made experiments with ſeveral other calculi, but have never met with any which were able to reſiſt the oiſter or cockle-ſhell lime-water.

As the calculous concretions of the urine have been thought to have ſome analogy to the tartarous cruſt left by wine on the ſides of the caſk, it may perhaps be worth while to obſerve, that lime-water diſſolves tartar pretty quickly, only as its virtue is ſoon deſtroyed by the acidity of the tartar, it muſt be frequently renewed upon it.

SECTION IV.

Experiments with lime-water and ſome of the animal humours.

The great power of lime-water to diſſolve the calculus being ſufficiently made out in the above experiments, the next ſubject of enquiry ſeemed to be, how far the nature of lime-water would be changed by mixing with the humours of our body, and conſequently what probability there was of its carrying its virtue along with it to the bladder.

21. I infuſed a piece of B, three grains in a mixture of one part of ſaliva and two parts and an half of oiſter lime-water; its ſurface in a few hours grew white, and on ſhaking the glaſs threw off white ſcales, and in two days warm digeſtion it loſt half its weight.

22. Another fragment of B, three grains, kept in an ounce of cyſtic bile, and three ounces of oiſter lime-water in a moderate heat forty-two hours, had near one grain and an half of its ſubſtance diſſolved in thin whitiſh ſcales.

23. A piece of B, five grains being digeſted in one ounce of freſh urine and three ounces of oiſter lime-water, in a moderate heat for three days, its ſurface was become all over white, about a grain of it was diſſolved, and the reſt ſomewhat rotten and friable.

Since from theſe experiments it appears, that the animal humours have nothing in their nature peculiarly deſtructive of the diſſolving quality of lime-water, we might reaſonably conclude a priori that it ſhould carry its virtue along with it, even to the bladder, and ſo in time diſſolve the ſtone.

SECTION V.

Experiments with lime-water, and fermented liquors and ſpirits.

24. Claret wine deſtroys the taſte of near double its quantity of lime-water, and the liquor has the colour of the wine rather heightened, and the taſte of wine and water; but upon adding a little more lime-water, it acquires a blackiſh colour, and diſcovers a little of the taſte of lime. I took two pieces of A, each weighing twenty-three grains; the one being put in lime-water and kept in a moderate heat, in five days had near five grains rotten and diſſolved; the other being put in one part of claret, and two parts of the ſame lime-water, and kept in the ſame heat for fifteen days was not affected.

25. An ounce of lime-water mixed with an equal quantity of ſtrong ale, not in any degree ſtale, had its taſte quite deſtroyed, at the ſame time that it weakened the malty taſte of the ale more than an equal quantity of common water. A piece of A, ten grains, after ſtanding thirteen days in this mixture in

a moderate heat had undergone no alteration. Small beer has the ſame effect, but in a leſs degree.

26. On mixing lime-water and vinegar no effervescence or ebullition ariſes; one ounce of the latter deſtroys the taſte of ten or twelve of the former; and a fragment of A, four grains, after lying eight days in this ſaturated mixture in a digeſting heat, was not any ways altered.

Hence ſuch as uſe lime-water ought to abſtain not only from all acids, but from wine, ale, and, ſo far as I have been able to obſerve, all fermented liquors.

27. A ſpoonful of Weſt-India rum mixed with the ſame quantity of lime-water, produces a liquor of a lemon colour both taſting and ſmelling ſtrong of the lime; a little vinegar added to this changes its colour, and deſtroys all taſte of the lime.

28. Rum, in which ſo much lemon-rind had been infuſed, as to give it a yellow colour, being mixed with an equal quantity of lime-water acquired a ſtronger yellow colour, but immediately became turbid.

29. Equal parts of French brandy and lime-water produce a liquor higher coloured than the brandy was before, and taſting ſtrong of lime; in an hour or two there falls a brown ſediment, and the liquor above becomes of a lemon-colour, not taſting of lime; but when the ſediment is ſtirred up it taſtes as before. Much the ſame thing happens to malt ſpirits and rum.

30. A piece of B, two grains, being infuſed in one part malt ſpirits and two parts oiſter lime-water in thirty-five hours warm digeſtion, its ſurface was become white, and it loſt about one-third of a grain.

From theſe experiments, it is ſafer for ſuch perſons as drink lime-water to uſe a little weak punch made without acids, than wine, or ale, or the like.

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SECTION VI.

Experiments with lime-water and animal food, alſo milk, honey and ſugar.

31. A piece of B, ſix grains digeſted warm for three days in mutton-broth one part, and oiſter lime-water two parts, loſt two grains.

32. A fragment of B four grains put in an ounce of a ſtrong decoction of freſh cod-fiſh, mixed with an ounce and an half of oiſter lime-water and digeſted in the ſame heat was in three days, twelve hours, reduced to one grain. Hence animal food may be allowed to ſuch as are under a courſe of lime-water for the ſtone.

33. A fragment of B, near five grains, was digeſted in one ounce of milk and four ounces of oiſter lime-water, forty-two hours, in a heat rather greater than that of the human body; ſome of it was diſſolved in white ſcales, and the greateſt part of it was become rotten ſo as eaſily to crumble.

34. A piece of B, five grains being digeſted in a ſolution of two drams of honey in three ounces of oiſter lime-water, fifty-ſix hours, in a moderate heat, loſt only one grain; what remained was as hard as ever.

35. A piece of B, five grains, being digeſted warm for forty-eight hours in a ſolution of two drams of white ſugar in three ounces of oiſter lime-water, was reduced to three grains, and what remained ſeemed not quite ſo hard.

Thus it appears that honey deſtroys in a good meaſure the diſſolving power of lime-water, while the ſame quantity of ſugar weakens it but very little.

SECTION VII.

Experiments with lime-water, and ſeveral fruits, herbs, and roots.

That ſuch a diet may be ordered for calculous patients as will leaſt deſtroy the virtue of lime-water, after

ter the experiments on animal food, we ſhall relate the effects of different vegetable ſubſtances upon it.

36. A fragment of B, eight grains, after four days warm digeſtion and ſeven days cold, in half an ounce of juice of ſtrawberries, and two ounces and an half of oiſter lime-water, had no appearance of diſſolution.

37. A piece of B, ſix grains, digeſted in half an ounce of juice of cherries, and three ounces of oiſter lime-water, ſix days warm, was not any ways affected.

38. A fragment of B, ſix grains, being put in one ounce of a ſtrong decoction of raiſins, and three ounces of oiſter lime-water was not any way changed by three days warm digeſtion.

Hence we may infer that all fruits which have any acidity, whether freſh or dried, ought to be abſtained from by ſuch as uſe lime-water with a view to the diſſolution of the ſtone.

39. A fragment of B, five grains, digeſted warm in one ounce of a decoction of aſparagus, and two ounces of oiſter lime-water, in a few hours began to turn white, and in thirty-ſix had thrown off in white ſcales a full grain of its weight.

Artichokes ſeem to deſtroy the virtue of lime-water a little more than aſparagus.

40. A piece of B, nine grains, by digeſting warm four days in one ounce of a decoction of turnep, and two ounces of oiſter lime-water, loſt more than a grain.

41. A fragment of B, three grains, being put in a mixture of decoction of parſley and lime-water in the above proportion, in three days warm digeſtion was reduced to one grain and one fourth, having thrown off the reſt in whitiſh ſcales.

42. In an ounce of decoction of onions, and two ounces of oiſter lime-water, a piece of B, ſeven grains, loſt by thirty-ſix hours warm digeſtion, one grain.

43. Juice of Lettice mixed with lime-water deſtroys its virtues rather more than any of the above.

44. A fragment of B, nine grains, in one ounce of a ſtrong decoction of marſhmallow root, and two ounces of

of oister lime-water, had by two days and eighteen hours warm digestion, above a grain of its substance dissolved, and a good part of the rest rotten and friable.

45. I put a piece of B, fourteen grains, in oister lime-water, in which some juniper-berries had been infused, which in two days and an half had above two grains dissolved. Green and bohea tea infused in the same manner do not considerably destroy the virtue of lime-water.

From these experiments it is probable that most of the following things may be safely used by such as drink lime-water, viz. artichokes, asparagus, spinnach, lettice, succory, parsley, purslane, onions, leeks, cellary, turnep, carrot, potatoes, radishes, green peas (a).

SECTION VIII.

Experiments with lime-water and several medicines.

46. Having dissolved one dram of soluble tartar in an ounce and an half of lime-water, I put in it a piece of B, four grains, which though kept in warm digestion five days and an half lost nothing of its weight but was somewhat more friable.

47. I digested a piece of B, four grains, in a solution of nitre in oister lime-water in the above proportion, which in five days and twelve hours dissolved near one grain.

48. A fragment of B, seven grains, after four days warm digestion in three ounces of oister lime-water, in which was dissolved one dram of bitter purging salt, scarce lost any of its weight, but its external surface was softer and somewhat rotten.

49. A piece of B, six grains, digested warm near four days in a solution of two scruples of Glauber's salt in two ounces of lime-water, lost none of its

(a) The juices and decoctions of onions, leeks, and cellary, are observed to have a considerable power of dissolving the softer kind of gravel-stones; and therefore ought to be preferred to most other vegetables for the diet of calculous persons.

weight,

weight, but its surface was rather more rotten than the stone in the last experiment.

50. A piece of B, six grains, by digesting warm in three ounces of oister lime-water, in which was dissolved one dram of sea salt, betwixt three and four Days, had a grain of its weight dissolved.

The lime-water does not dissolve most of the above salts, but so as the greatest part after standing a little falls to the bottom; upon which account I kept the stone in these experiments suspended in the middle of the phial by a thread.

Hence salts, even those of the neutral kind, destroy considerably the virtue of lime-water; and if the dissolving power of lime consists in its extracting the muriatic salts out of the calculus (see below No. 60.) lime-water when saturated with any of the above salts must be less effectual.

51. A piece of B, four grains, by thirty-six hours warm digestion in a solution of seven grains of aloes in two ounces of oister lime-water, was reduced to about three grains.

52. I infused ten grains of powdered rhubarb in three ounces of oister lime-water for twelve hours, after which I immersed in it a piece of B, six grains; in thirty-two hours warm digestion, near two grains of it were rotten and dissolved.

53. Having infused in the same manner ten grains of powder of jalap in three ounces of oister lime-water, I digested in it warm a fragment of B, six grains, for thirty-two hours, which was reduced to five grains.

54. A piece of B, four grains and an half, being for thirty-four hours digested warm in an infusion of half a dram of senna in three ounces of oister lime-water, lost one grain.

55. A piece of B, four grains and an half, being kept thirty-four hours in a solution of two scruples of manna in two ounces of oister lime-water, in a moderate heat, lost above a grain.

Hence, if by drinking lime-water, the body should be rendered costive, it will be better to use some of the

the laſt mentioned purgatives than any of the ſalts in the beginning of this ſection.

SECTION IX.

Experiments ſhewing the change made on lime-water by boiling, and being expoſed to the open air, &c.

56. Twelve ounces of lime-water being boiled pretty quickly into four, had loſt ſome of its virtue; for whereas before boiling, a blackiſh colour was produced by two parts of it to one of claret, now it required near two and an half.

57. If a bottle be filled with lime-water, and cloſely ſtopt, it will keep for any time without loſing any of its virtues; but having expoſed four ounces of it in an open veſſel, it began very ſoon to throw up a ſcum, and let fall ſome ſediment of the ſame nature; in three days it had loſt much of its fiery taſte, and ceaſed to turn claret blackiſh, and in five days when the taſte of the lime was almoſt quite gone, it neither changed the colour of ſyrup of violets, nor had any effect in diſſolving the ſtone; and this happens equally ſoon when placed in the cold air as in a moderate heat; the time in which lime-water thus expoſed loſes its virtue, will be more or leſs according to the proportion which the ſurface bears to the quantity of fluid. Since lime-water when thus expoſed continues to change the colour of ſyrup of violets near two days after it has ceaſed to have any effect upon claret, this laſt ſeems to be the ſevereſt teſt of its goodneſs.

The ſcum that is left behind after the lime-water is become effete or evaporated, being well beat and mixed with ſyrup of violets, and then ſome common water added to it, the mixture acquires, after a little ſtanding, a green colour. Hence it ſeems probable, that a great part of the virtue of lime-water conſiſts in this ſcum.

58. Ten parts of lime-water mixed with one of vinegar does not throw up any ſcum; but when evaporated in a moderate heat, leaves a dark coloured ſediment.

59. It has been generally thought that no ſalt could be got from lime-water, nor could I by evaporation procure any, what remains is rather a fine lime; yet upon adding one part white wine vinegar to ten or twelve parts ſtone lime-water, after ſome days cryſtalline concretions adhered to the ſides of the glaſs, and having infuſed a fragment of B in ſome oiſter lime-water made with ſhells which had laid fifteen hours after taking from the fire, in three or four days a prodigious number of ſmall pointed cryſtalliſations appeared, but it is probable they were not owing to the lime-water, but to ſome ſalts uſed in former experiments, of which the phial had not been well cleaned (a). We are told indeed that Mr. Leewenhoeck diſcovered by his microſcopes in lime-water a great number of ſaline rigid particles (b).

60. As lime-water does not efferveſce with acids, and as almoſt the only thing wherein it betrays any alkaline quality is its turning ſyrup of violets green, it ſeems to partake but little of that nature; nor do its virtues conſiſt in an alkali, but are more probably owing to a fixed concentrated fire; for quicklime efferveſces leſs with vinegar than with ſmall beer, and is very difficultly ſlaked by either, while water which is neither acid nor alkali being poured upon it produces great ebullition and heat, and quickly diſſolves it.

All acid and aceſcent liquors not only deſtroy the virtues of lime-water, by depriving it of the ſmall degree of alkali it poſſeſſes, but as Dr. Hales has found ſeveral bodies remarkable for abſorbing or deſtroying elaſtic air (c), ſo it is not unreaſonable to ſuppoſe that there may be others which have the ſame effect upon fire, and that acid and aceſcent liquors which are potentially cold ſhould have it moſt remarkably.

(a) Having lately obſerved ſomething of the ſame appearance from lime-water made with oiſter ſhells, newly taken out of the ſea, and neither boiled nor well waſhed before calcining, I am more inclined to believe theſe cryſtalliſations were owing to the ſea ſalt which remains in the ſhells even after calcination.

(b) Muſgrave de Arthritide. cap. 19. § 4.

(c) Hales's Statics vol. 1. analyſis of the air.

The

The drinking of lime-water does not render the urine alkaline, for it neither effervesced with vinegar, nor turned syrup of violets sensibly green, although the taste of the lime was perceivable in it; nor does quicklime itself change any of the humours of our body into an alkaline nature; upon adding it indeed to urine an intolerable fiery vapour arises, but which is not alkaline, for being mixed with acids no effervescence ensues, though its fiery nature and volatility are greatly diminished by them; nor has any art yet been able to procure from this spirit the smallest quantity of alkaline or indeed any other salt (a).

From this it is evident, that the strong alkaline urine voided by such persons as have taken Mrs. Stephens's medicines is not owing to the lime in them, but probably arises from the alkaline salts which make up a considerable part of the soap; and the dissolving virtue of such urine does not seem to consist (as Drs. Kirkpatrick and Hartley (b) think) in its alcaline nature, since Mr. Miller's urine had this power without that quality, and since Dr. Hales has shewn that the potash has no effect in dissolving the stone (c).

Quer. May not the dissolving virtue of lime consist in the power which it seems to possess of extracting the muriatic salts out of the humours of our body.

From the great affinity supposed to be betwixt the gout and gravel, it might be worth while to try the effects of lime-water in this disease also; and Dr. Cheyne having asserted that the gouty chalkstones and gravel-stones were, as to their essential qualities, the same, and yielded both the same principles when chemically treated (d), I infused some of them in lime-water. At first they swam; but after emitting a great quantity of air-bubbles, fell to the bottom, and in a day or two became as soft as butter; but on trial, common had the same effects as lime-water.

(a) Boerhaave chemia vol. 2. process 97. (b) Kirkpatrick's case, and Hartley's view of the present evidence, &c. (c) See below No. 62. (d) Cheyne on the gout, p. 72. edit. 4.

S E C T.

SECTION X.

Experiments with lime-water and ſoap, &c.

It appearing from Dr. Hales's experiments that ſoap is poſſeſſed of a conſiderable power of diſſolving the ſtone, and that this is chiefly owing to the lime which enters its compoſition, I was excited to make ſome experiments on it, with a view ſtill further to diſcover wherein its virtue lay, and what proportion it bears to that of lime-water, whether lime-water might not be improved by it, and how far their lithontriptic quality is deſtroyed by the ſame things.

62. A piece of A, nine grains, digeſted warm fifteen days in a ſolution of two drams and an half of potaſh in four ounces of boiling water, loſt little of its weight, nor was it ſoftened to any depth, however its ſubſtance ſeemed more friable.

63. I boiled fourteen ounces of ſtone lime-water with five drams of potaſh to ſix ounces; a piece of A, eleven grains and an half, after ſtanding in it twelve days in a gentle heat, loſt ſeven grains and an half.

64. A pound and an half of boiling water in which an ounce of potaſh was diſſolved, being poured on two ounces and an half of quicklime, after the ebullition was over and the lime fallen to the bottom afforded a very fiery corroſive liquor; a piece of A, ten grains and an half was diſſolved in it in fifteen or ſixteen hours in a moderate heat. A lixivium of the ſame kind, which ſeemed not ſo ſtrong, diſſolved a piece of B, three grains, in twelve hours, while a fragment of the ſame calculus, fourteen grains, required three days and ſix hours of a cold maceration in ſingle aqua fortis (a) to diſſolve it.

Inſtead of an ounce I diſſolved two drams of potaſh in one pound and an half of water, and poured it on quicklime as above, but found that any advantage I expected from its greater lithontriptic virtue was more

(a) Pharmacop. Edinburgenſ. p. 175.

than balanced by the extreme nauſeouſneſs communicated to it by the alkaline ſalt.

65. A piece of A, ſeventeen grains and an half, being put in a ſolution of Alicant ſoap in warm water, after digeſting warm ſix days, had a thick white cruſt all round it ready to fall off, which when removed, the undiſſolved part weighed fourteen grains; in nineteen days it was reduced to ſix grains.

66. It is not eaſy to account for the diſſolving virtue of Alicant ſoap; for of it's three ingredients lime-water, alkaline ſalt and oil (a), only the firſt has any conſiderable power this way, the ſecond having very little, and the third none at all. The firſt and ſecond mixed together have not more than the firſt alone (b); the ſecond and third united have none at all, and yet of theſe two laſt the ſoap chiefly conſiſts: There is indeed a conſiderable deal of the efficacious part of lime-water, which is the ſcum (c) or reſiduum after evaporation in ſoap, although the water bears but a ſmall proportion to the other ingredients (d). Beſides it is probable, that the lubricity given to the ſoap by the oil may enable the active parts of the lime-water and potaſh to enter the pores, and penetrate more eaſily into the ſubſtance of the calculus, and thus facilitate its diſſolution; for the virtue of ſtone lime-water is increaſed by Alicant ſoap, and is greater than the aggregate of the diſſolving powers of the ſoap and lime-water when unmixed; a piece of A, eighteen grains after lying five days in it in a moderate heat was reduced to ſix grains ſeveral white cruſts having fallen off; after ſtanding twenty-four hours more no further alteration was made, and the ſolution had loſt its virtue with the taſte of the lime-water; I therefore put the calculus in a new ſolution, where in three days it was all diſſolved, excepting a ſmall nucleus weighing a grain.

(a) See the note at the beginning of this paper. (b) Compare No. 10, 11 and 12, with No. 63 above (c) See No. 57 above. (d) Mr. Geoffroy ſays, that in 180 pounds of ſoap there are only 15 pound of a watery humidity. See Hales's experim. p. 15.

66. Another

[66.] Another time the experiment did not ſucceed ſo well; for a piece of B, ten grains, in ſuch a ſolution, in two days and nine hours, only loſt a little more than three grains, while a piece of the ſame weight in ſtone lime-water alone loſt in that time two grains: Whether the ſoap was not ſo good or duly proportioned as in the firſt I cannot affirm.

N. B. Unleſs the lime-water be pretty hot and the ſoap agitated for a conſiderable time, they will not unite.

The two laſt experiments account for the ſucceſs which attended the ſtone lime-water in Mr. Miller's caſe, which derived its efficacy in a good meaſure from being taken along with a conſiderable quantity of ſoap.

67. Oiſter lime-water is a more powerful diſſolvent than that of ſtone-lime, but ſoap will not unite with it, which is owing to the ſea-ſalt in the oiſter ſhells (a); however if the ſhells have been long expoſed to the weather before calcination, the lime-water made from them will unite with ſoap, as will cockle-ſhell lime-water, but without any increaſe of their virtue.

Stone-lime-water is undoubtedly as ſtrong of the lime as the animal lime-waters, and the effects of ſtone-lime in ſeveral caſes ſhew it to be rather ſtronger than that of ſhells; ſo that the different diſſolving powers of theſe two waters muſt be owing to ſome peculiar quality in the ſhell-lime; poſſibly it may be more ſaponaceous as well as penetrating, and conſequently the effect of ſoap will not be ſo remarkable on it.

[67.] Having poured a very weak ſolution of ſoap upon ſome calcined oiſter-ſhells, I procured a liquor taſting ſomewhat of ſoap, and ſtrongly of lime, which

(a) I boiled ſome oiſter-ſhells four or five hours, changing the water thrice in that time, thinking this might free them of their ſalt, and render their lime-water miſcible with ſoap, but without any effect; however, I ſhould adviſe the boiling and waſhing of theſe ſhells before they are calcined, as it ſeems to free the lime-water of a ſomewhat fiſhy taſte it otherwiſe has.

(b) It raiſes much greater heat and ebullition with cold water than ſhell-lime.

in thirty eight hours warm digeſtion reduced a piece of B, four grains, to one grain and one third.

I diſſolved three drams of ſoap in thirty five ounces of boiling water, and poured it on five ounces of calcined oiſter-ſhells; the lixivium taſted ſtrong of the ſoap as well as lime, and was pretty pungent and diſagreeable; being mixed with urine it produced the ſame appearance as ſimple lime-water (a), but raiſed a ſmell like that of burnt horn. A piece of B, three grains and an half, being immerſed in it, was in twenty four hours warm digeſtion reduced to one grain. The ſtrength of this lixivium is probably owing to the fiery particles of the quicklime, which are more ſtrongly attracted by the ſolution of ſoap (by means of the alkaline ſalt in it) than by common water.

68. A ſolution of ſoap in freſh ſmall beer had no effect on ſome pieces of A in eight days in a moderate heat.

69. A ſolution of ſoap in one part Scotch aqua vitæ, and two parts water has very little virtue, though more than the preceding.

Thus we ſee the diſſolving power of ſoap as well as lime-water (b) is deſtroyed by fermented liquors, and weakned by ſpirits, and conſequently that ſuch as uſe it ought to abſtain from them.

70. A piece of B, ſeven grains, kept in a ſolution of Alicant ſoap in a gentle heat for four days, loſt two grains of its weight.

71. At the ſame time I infuſed two pieces of B, each weighing eight grains, the one in two ounces of the above ſolution with a dram of white ſugar, and the other in two ounces of the ſame with a dram of honey; the calculus in the ſolution with ſugar loſt about two grains, the other not above one grain.

As in refining ſugar a good deal of lime-water is employed, ſome of its more efficacious parts may adhere to it. Hence ſugar deſtroys the virtue of lime-water but little, and of ſoap not at all.

(a) See No. 8. above.

From

From this experiment it appears, how much the virtue of Mrs. Stephens's medicines muſt be weakned by honey. Sugar may be ſubſtituted to advantage.

72. B, five grains and an half, put in a ſolution of Alicant ſoap made with a ſtrong decoction of aſparagus, after digeſting warm for five days, loſt near two grains.

73. A piece of B, ſix grains, put in a ſolution of the internal bluiſh part of Alicant ſoap made with warm water, and digeſted warm for three days, loſt two grains; Another piece of B, of the ſame weight, digeſted fifty eight hours warm and fifteen cold in a ſolution of the external part of the ſoap, loſt only about three fourths of a grain. Hence the internal part of the ſoap ſhould only be made uſe of as a diſſolvent for the ſtone. And hence likewiſe, it is very improper to form ſoap into pills for this purpoſe, unleſs for immediate uſe; for as the air acts only on the ſurface of the ſoap, the more the ſurface is increaſed, the greater will the quantity be which is deprived of its virtue. From this it ſtill further appears, that the diſſolving virtue of ſoap lies chiefly, if not wholly, in the lime which is in it (a), and not at all in its alkaline nature, which is not deſtroyed by its being expoſed to the air.(a)

74. Three drams of potaſh, five drams of oil of olives, and four ounces of ſtone lime-water, being mixed and boiled over the fire to the conſumption of one half, I put a piece of A in it; but after ſtanding in a gentle heat ſeveral days, found no appearance of its being in a diſſolving ſtate.

As in this mixture the oil was not ſufficiently united with the potaſh and lime-water, I imagine the ſurface of the ſtone being beſmeared by it, hindred theſe from having that effect they otherwiſe would have had (b).

From the ſame cauſe I fancy it was that ſoap lees and oil did not diſſolve the calculus in one of Dr. Hales's experiments (c); he ſeems indeed to think that

(a) In this fact I preſume the author of this excellent eſſay is miſtaken; for ſoap expoſed to the air loſes of its alcaline quality, the ſalts of ſo much of it as is penetrated by the air becoming of a neutral kind. (b) See No. 62. above. (c) Page 31.

in order to the ſoap lees exerting their virtue, the oil muſt be ſeparated from them, which he reckons is done in the courſe of the circulation; but, with ſubmiſſion, I think it only neceſſary that the oil ſhould loſe its nature ſo far as to become miſcible with water: Thus a ſolution of ſoap diſſolves the ſtone, although the oil be not ſeparated from the other ingredients.

SECTION XI.

Propoſal of the method of cure.

Let the patient ſwallow, in any form which is leaſt diſagreeable, an ounce of Alicant ſoap every day, and drink three pints or more of oiſter or cockle-ſhell lime-water; if he takes the ſoap in pills, or ſhaved down as Mr. Miller did, he may divide it into three doſes, the largeſt to be taken faſting in the morning early, the ſecond at eleven before noon, and the third at five after noon, drinking after each doſe a large draught of the lime-water, the remainder of which he may take after meals, inſtead of any other liquor: The diſagreeable taſte of the lime-water may be blunted by adding a very little ſweet milk to it, and is quite deſtroyed by waſhing one's mouth immediately after drinking it with a little vinegar and water, which however muſt be carefully ſpit out again (a). But if the patient finds difficulty in taking the ſoap in this form, or if it does not ſit eaſy on his ſtomach, let him diſſolve (b) an ounce of it in a pint and an half of warm lime-water, made with ſhells which have been long expoſed to the weather, and take this at three different times, drinking the reſt of the lime-water by itſelf. If the ſhell-lime-water cannot be had, let him take the ſame quantity of ſtone lime-water, with at leaſt an ounce and an half of ſoap, ſince

(a) A dram and an half, or two drams of juniper-berries infuſed in every quart bottle of it will mend its taſte much.

(b) A ſolution is preferable to a decoction. See No. 56. above.

its

its diſſolving power is ſo much increaſed by it (a). A ſolution of ſoap in lime-water has not ſo diſagreeable a taſte as a ſolution or decoction of it in common water. The ſoap is not only proper to be taken along with the ſhell-lime-water, as it is endued with a conſiderable power of diſſolving the ſtone, but likewiſe as it will contribute to keep the belly eaſy, and prevent any coſtiveneſs which might otherwiſe be occaſioned by the lime-water; but in caſe of an invincible averſion to ſoap, the above experiments give us reaſon to think that oiſter or cockle-ſhell lime-water alone drunk in large quantities will have greater effects in diſſolving the ſtone, than ſtone-lime-water even when aſſiſted by ſoap (b).

At firſt the patient ſhould begin with a ſmaller quantity of lime-water, than that mentioned above; which he may increaſe by degrees, and ought to perſevere in the uſe of, eſpecially if he find any abatement of his complaints, or ſymptoms of the ſtone diſſolving, for ſeveral months, nay if the ſtone be large, years, during which time he ſhould abſtain from acid and fermented liquors: for his drink he may have water and milk, or a ptiſan made with roots of marſh mallow, parſly and liquorice; but if he has been accuſtomed to more generous liquors, and cannot confine himſelf thus far; he may be allowed a little weak punch made without acids; only as the virtue of ſoap is much weakned when diſſolved in punch (c) and entirely deſtroyed by ſpirits (d); and as quick-lime has its nature conſiderably changed by them (e), they ought not to be drunk by themſelves, nor even in punch to any quantity. It will alſo be proper to be ſparing in the uſe of ſalt meats, honey and acid fruits, while milk, ſugar, and the vegetables mentioned N. 39 -- 45. may be ſafely uſed. The patient

(a) No. 66. above. (b) Compare No. 14 - - - - 20, with No. 66. See alſo the table at the end of this eſſay.

(c) See No. 69. above. (d) Hales's Experiments, p. 2.

(e) See No. 1. and 2. above.

ought to drink no more of any liquors than is ſufficient to quench his thirſt, and ſhould retain his urine as long as he can without uneaſineſs, that it may have the greater time to act on the ſtone. If the lime-water occaſions coſtiveneſs, it will be proper now and then to take any of the purgatives mentioned N. 51. - - 55.

2dly, Such as have a ſtone in the bladder ſhould, at the ſame time they are taking the medicines above directed, have four, or more, ounces of tepid ſhell-lime-water injected into their bladder every day, to be retained as long as they can without pain, for which purpoſe they ſhould evacuate their urine immediately before the injection: Were it not for the trouble of introducing the catheter, ſuch injection might be made at leaſt twice a day, and if a flexible catheter were always kept in the bladder (a) it might be done as often as one pleaſed, and the diſſolution of the largeſt ſtones quickly procured. It will be proper to let the patient drink lime-water ſome weeks before he uſes it by way of injection, in order to mitigate his pains.

That the injection of lime-water into the bladder may be more ſafe and attended with leſs uneaſineſs, a dram of ſtarch may be diſſolved in ſix or ſeven ounces of oiſter-lime-water, and juſt brought to boil over the fire ſtirring it all the while; for, having put a piece of B, ſeven grains, in ſuch a mixture as this, in three hours time there was a white rotten cruſt formed all round it, which fell off on ſhaking the glaſs, and in twenty four hours time above a grain of it was diſſolved. The heat uſed in this experiment did not exceed 100 degrees in Farenheit's thermometer.

The fourth part of the yolk of an egg being mixed with ſix ounces of lime-water, does not weaken its virtues any more than the ſtarch, and may be occaſionally uſed in place of it.

Such as have no ſtone in the bladder, but are ſubject to frequent fits of gravel in the kidneys, might very probably prevent theſe, by drinking every morning

(a) Heiſter. Chirurg. p. 883 and 938.

two

two or three hours before breakfaſt, a pint of oiſter or cockle-ſhell lime-water, which though it might be too ſmall a quantity to have great effect in diſſolving the ſtone, yet would probably prevent any new concretions.

SECT. XII.

Comparative value of the ſeveral medicines.

THAT the method of cure juſt now propoſed, may appear with greater advantage, I ſhall ſtate in few words the comparative value of the ſeveral medicines which are thought to bid faireſt for diſſolving the ſtone; of theſe only lime-water and ſoap can be ſafely taken into the human body, ſpirit of nitre, ſoap-lees, or the fiery lixivium of N. 64. and quick-lime being all mortal poiſons, are only capable of being uſed when diluted in a large quantity of ſome watery vehicle, and even they do not promiſe ſo much as lime-water; for as the virtue of ſpirit of nitre ſeems to conſiſt in its extraordinary corroſive acidity, which muſt be deſtroyed before it get into the blood, and ſtill more ſo before it arrives at the bladder, nothing can reaſonably be expected from it or any medicines of this kind. In anſwer to this it has been alledged that although vegetable acids are entirely changed by the digeſtive powers of the human body, yet this is not the caſe with reſpect to the mineral acids (a); but if the mineral acids above mentioned are entirely changed by the powers of the human body, they can have no effect in diſſolving the ſtone; and if they are not deſtroyed, they become poiſons, and conſequently cannot be ſafely exhibited.

With regard to the ſoap-lees, or the fiery lixivium N. 64, as they owe a great deal of their deſtructive quality to an ingredient which has ſcarce any effect in diſſolving the ſtone (b), they do not ſeem ſo well calculated for this end as lime-water, which at the ſame

(a) Boerhaave Chemia. (b) See No. 62. above.

time that it is ſtrongly ſaturated with that to which the ſoap lees owe their virtue, is free of the alkaline ſalt which renders them in a great meaſure ſo noxious. But to ſet the virtue which theſe two medicines have in diſſolving the ſtone ſtill in a clearer light, it may not be improper to compare the effects which ſoap lees had on Dr. Jurin, with what lime-water had on Mr. Miller.

Dr. Jurin's ſtone in his bladder ſeems to have been but of two or three months ſtanding, when he began his medicines; whereas Mr. Miller's was above fifteen months; Dr. Jurin took ſoap-lees in very large doſes for near five months before he paſſed any ſtones; and after taking them near ſeven months, does not ſeem to have been perfectly cured (a); Mr. Miller, in ſeven weeks after he began to drink lime-water, voided one ſtone, as in three months he did another, and has ever ſince been perfectly well. Mr. Miller had no pain upon uſing the lime-water (b), but in a few days began to perceive a gradual abatement of all his complaints, while Dr. Jurin had his pains conſiderably increaſed by the ſoap-lees at firſt, nor does he ſeem to have had any ſenſible eaſe, till after uſing them above four months.

As for quick-lime, its virtues are more plentifully and ſafely conveyed into the blood by means of lime-water than any way elſe; if allowed to ſlaken for two months, as Mrs. Stephens has directed, it gains in mildneſs only what it loſes in virtue (c), though even after all it is a medicine which neither ſeems innocent nor agreeable.

(a) See his caſe, p. 14.

(b) Nor is Mr. Miller a ſingle inſtance of this; for I have juſt now two patients drinking cockle-ſhell lime-water for the ſtone; who, inſtead of having their pains increaſed by it, had not uſed it much above a fortnight, when they found themſelves eaſier. One of them, on diſcontinuing the lime-water, ſoon grew worſe, but on having recourſe to it again found himſelf better.

(c) See No. 20. above.

But

But further, how strongly soever the above three medicines may be indued with a virtue of dissolving the stone, yet the quantity of watery fluid necessary to be added to them before they can be used with any safety, is so large, that the mixture does not possess near so great a dissolving virtue as lime-water (a), which has this advantage, that it may safely be injected into the bladder.

Upon the whole, we have found in lime-water (that especially which is got off oister or cockle-shells) a menstruum for the calculus so innocent and mild, that it may be taken into the stomach without any harm, and injected into the bladder without the least danger of corroding it.

SECTION XIII.

The dissolving Powers of the Menstruums.

IF, in the foregoing experiments, the weights of the several pieces of the same stones, and the times they were immersed in the different menstrua had been all equal, the strengths of the menstrua would at first sight have appeared; but since the case is otherwise, I shall subjoin a table of the proportions which the dissolving powers of the menstruums in the above experiments bear to one another, but previous to it I shall briefly mention the grounds on which it is built.

I suppose that the times in which different pieces of the same homogeneous stone will dissolve in any menstruum, to be as their surfaces, and supposing their surfaces to be as the square-roots of their weights or quantities of matter (which would be exactly true, were they all either cubes or spheres, or their figures exactly

(a) Soap lees must be diluted with at least sixteen times their quantity of a watery fluid, in order to save the throat and stomach from their acrimony. Spirit of nitre and aqua fortis have not yet, so far as I know, been ventured upon in any shape, and Mrs. Stephens's powder diluted as she orders it, is no better than so much weak lime-water.

similar)

ſimilar) the times required for two different pieces of the ſame ſtone to diſſolve in any menſtruum will be, cæteris paribus, as the ſquare-roots of their weights.

If the weights of two pieces of the ſame homogeneous ſtone be equal, and the times which they are immerſed in different menſtruums be alſo equal, the powers of the menſtruums will be as the quantities diſſolved.

If the times, weights and the quantities diſſolved be unequal, the powers of the menſtruums will be as the quantities diſſolved directly, and as the times and ſquare-roots of the weights inverſely. Thus ſuppoſing *m*. M. to be the menſtruums, *q*. Q. the quantities, *t*. T. the times, *w*. W. the weights. $m : M :: q \times T \times \sqrt[2]{W} : Q \times t \times \sqrt[2]{w}$.

If two ſtones of different textures be put in the ſame menſtruum, the hardneſs of the one will be to that of the other as the times, and ſquare-roots of the weights directly, and as the quantities diſſolved inverſely. If $m = M$, then $h : H :: t \times \sqrt[2]{w} \times Q : J \times \sqrt[2]{W} \times q$.

Hence by comparing experiment 15 and 16, the hardneſs of the ſtone A is to that of B, as 380 to 406, and this it was neceſſary to take notice of, as in ſeveral articles of the following table, an allowance was made for this difference in the hardneſs of theſe two ſtones.

TABLE.

TABLE.

MENSTRUUMS.	*Dissolving powers.*
Stone-lime-water. Exper. 11. —— ——	202
Oister-shell lime-water. Exp. 16. —— ——	583
Cockle-shell lime-water. Exp. 17. —— ——	583
Lime-water made with oister-shells, which had lain 35 days after calcination in the open air. Exp. 20. —— —— ——	215
Oister-shell lime-water and honey. Exp. 34. —	146
Oister-shell lime-water and sugar. Exp. 35. —	340
Stone-lime-water in cold digestion. Exp. 13. —	091
Oister-lime-water in cold digestion. Exp. 18.	229
A solution of soap in common water. Exp. 70.	143
The external part of soap. Exp. 73.	079
Soap in stone lime-water. Exp. 66. First trial. ——	406
Second trial. ——	494
Exper. [66.] ——	328
Soap with sugar. Exper. 71. —	134
Honey. Exp. 71. —	67
Lime-water made by pouring a weak solution of soap on calcined oister-shells. Ex. [67.]	681
Lime-water made with a stronger solution of soap. Exp. [67.] —— ——	1003
Potash and stone-lime-water boiled. Exp. 63.	178
A lye of potash and quicklime. Exp. 64. —	3449
Another lye of the same kind. Exp. 64. —	1768
Aqua fortis simplex in cold digestion. Exp. 64.	858
And supposing its dissolving power to be increased in a digesting warmth, in the same proportion as that of oister-lime water, then the dissolving power of aqua fortis simplex in warm digestion will be —	2184

The

The following history is a further instance of the efficay of lime-water in the cure of the ſtone.

James Litſter in Mackie's Miln, in the county of Fife, aged fifty ſeven, about nine years ago, was hurt by a ſevere fall on a mill-ſtone, and after that began to be troubled with gravel in the kidneys and ureters: At this time he had a great pain in one of his kidneys, and ſtoppage in his belly like an iliac paſſion: After a clyſter he had paſſage, and was eaſier, and the ſtone or ſtones paſſed into his bladder, but he did not obſerve that he had voided any with his urine till a great time after; and ever ſince this he has had all the ſymptoms of a ſtone in the bladder, he has great pain in making urine, is not able to uſe exerciſe, upon motion feels the ſtone pricking him in his bladder: Riding at a trot gives him remarkable uneaſineſs; and after it, or much walking, his urine is generally tinged with blood. He has been ſubject ſeveral years to have his ſymptoms at certain periods exaſperated; during the fit he is in great diſtreſs, and his urine, which he has an inclination to make every two or three minutes, comes away in drops with ſevere ſtimulating pains. The fits generally laſt three, ſometimes four weeks, and return after an interval of fourteen or twenty days.

He took Mrs. Stephens's medicines for two months without any benefit, but found his pain increaſed by them, his ſtomach put out of order, and appetite greatly deſtroyed. He has alſo uſed ſoap for ſome time, to the quantity of three fourths of an ounce a day, but without any ſenſible benefit.

I adviſed him along with the ſoap to drink lime-water made with calcined cockle-ſhells, beginning with two pints, and if it agreed with him, increaſing the quantity to three pints or more every day.

Upon the firſt of June 1742, a few days before he began to uſe the lime-water, he was attacked with a ſevere fit of pain, and difficulty of urine, which laſted twenty days, in which time he paſſed a good deal of tough

tough ſlime; but in eight or ten days after this was over, he found himſelf eaſier than he had been for a year before, and made his urine more freely and with leſs pain.

On the 2d of July having uſed the lime-water ſcarce four weeks, he rode fourteen miles; during the riding, he felt ſome pain in his bladder, notwithſtanding which, next day he was quite eaſy; whereas formerly, if he had made any journey on horſeback, he was ſure the day following to be in the utmoſt diſtreſs, and to continue ſo for ſeven or eight days.

When he ſtoops down, or makes any ſudden motion, he ſtill feels the ſtone puſhing him in his bladder, but not near ſo ſharp as uſual. His urine, ſince he uſed the lime-water, depoſites a great deal of whitiſh ſediment: and he thinks it has given him a better appetite than he has had for ſeveral years paſt.

From the ſecond of July, he drank above three pints of lime-water every day, and was very eaſy till the twentieth of that month, when he had a fit as uſual, but it laſted only eleven days, and now it was only in making urine that he had any pain; and this was not ſo ſevere neither. His belly being generally coſtive during the fit, I ordered him ſenna-tea, from which he had conſiderable relief.

He continued very well all the month of Auguſt, and walked on the twentieth, ſix miles in few hours, without any pain or trouble; whereas for ſome years he could not walk even one mile without much pain.

Upon the firſt of September, he found his urine much obſtructed, and had a fit which laſted nine days; but though his provocations to urine were frequent, and the difficulty in making it conſiderable, yet after voiding a few drops he was eaſy, and had no ſtimulating pains. From this to the end of October laſt he was as well as if he had no ſtone, was able to go about his buſineſs, and was fit for any work that did not require great ſtrength. He can ride now as well as ever, and never finds any thing pricking him in his bladder, not even when he has the fit. From the beginning of

July

July he made no uſe of ſoap. He has been ſo ſenſible of the benefit he has had by drinking lime-water, that he is reſolved to perſiſt in it in hopes of a complete cure.

I have had occaſion to order oiſter and cockle-ſhell lime-water for ſeveral others, but have not yet met with an inſtance where it was drank to two or three pints a day, and any tolerable regimen obſerved, without the patient's finding himſelf in a few weeks ſenſibly eaſier. When the ſtone is ſmall this will happen moſt remarkably, as was the caſe with Mr. Miller, but if it is very large, even after its ſurface is ſoftened, and the rough points worn off it by the lime-water, it is not to be imagined but that by its bulk it muſt ſometimes give uneaſineſs, eſpecially in making urine; but the patient has this to comfort him, that while he continues his medicine, the ſtone is daily growing leſs.

I ſhall only make one obſervation upon this hiſtory, which the moſt rigid infidels with regard to the diſſolution of the ſtone muſt acquieſce in, and that is, Supposing lime-water could not diſſolve the ſtone, yet ſince it is capable of giving ſuch eaſe and quiet to thoſe who labour under it, whether would it not be more adviſeable for ſuch, eſpecially if advanced in years, to reſolve upon drinking a bottle of this every day during their whole life, than ſubmit to one of the moſt cruel, and, at the ſame time, not the leaſt dangerous operations in ſurgery?

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